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Forthcoming Events.

MAY 7-8.

Iron and Steel Institute:—Annual meeting at the Institution of Civil Engineers.

MAY 8.

Institution of Mechanical Engineers:—Extra general meeting in London.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

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Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Prospects of the Electric Furnace.

A considerable amount of space is devoted in this issue to the subject of the electric melting of iron, steel and non-ferrous metals. We have purposely included an article on the Val d'Aosta scheme, by Dr. Giolitti, as it emphasises the contrast in industrial conditions between Great Britain and Italy. In neither Mr. Stobie's nor Mr. Etchell's Paper was any great prospect held out for any real extension of the home market for the electric furnace industry, and we can well imagine the pessimist comparing the fortunate Italian with his unfortunate British competitor. The Italian has the great asset of cheap electricity from the "white coal" on the Alps. But that is not everything. Primarily, in some mild winters there may be an insufficient supply of snow to keep all the factories running on hydro-electric power amply supplied with electricity. Again, we doubt whether one could economically carry out in any one works in Italy the orders contained on two pages of an average Sheffield steelworks order book, with its demand for a multitude of different compositions and sizes and shapes of bars. Sheffield can only tackle such orders by means of the numerous rolling mills and forges working for the trade.

As for the making of iron, steel and other castings electrically, there must be available either an abundance of steel scrap or pig-iron—preferably the former. As Italy possesses no coal, they have to import the scrap, which they have been doing very heavily for some considerable time. So far as pig-iron is concerned, they can either import or make it electrically, but the latter demands a reducing agent — either coke or charcoal. Charcoal is only available to a limited extent. Thus in general terms it can be stated that the whole of the Italian metallurgical industries are unnatural, and cannot be expected to do much more than to fill their own protected market.

Both authors struck the same note in suggesting that a foundry might profitably install an electric furnace for both iron and steel. After making a charge or two of steel a white-hot furnace is available for treating cupola metal, or making quite cheaply an excellent synthetic cast or malleable iron. German engineers have hinted that for getting the very best properties out of the most recent development of cast iron an electric furnace is desirable, and what is desirable one year may be an essential the next. It has been stated that ships are carrying not merely spare liners for their Diesel engine cylinders, but also the patterns. If any truth is to be attached to this statement, then the installation of even a large electric furnace is not to be ruled out. For purely iron foundry purposes we believe a more cheaply constructed furnace could be made available. The tilting gear could be eliminated and the old-fashioned tap-hole incorporated. Instead of enclosing in steel plates, brickwork reinforced by cast iron plates and tie-bars could be substituted. The electrode gear, too, could be simplified, whilst the initial heating of the furnace could be done by oil or an attached firebox, confining the use of electricity to super-heating and refining. As a basic lining is essential and dolomite is prone to disintegrate, a magnesite brick lining, with no rammed material above it is suggested. Cast iron is never so "searching" as steel.

Unless steel is to be made in the furnace, the design of the furnace could be considerably simplified. As for the electricity costs, we note that in South Wales one district has been "playing off" another district against it and brought about a reduction. By extending this system there is a chance that electric melting could be extended to the ultimate benefit of the large power stations. The linking up of power stations, the standardisation of pressures, etc., the electrification of railways would all help what is now a struggling industry, but one which will ultimately expand to far beyond war-time proportions.

The Glasgow Convention.

The Annual Convention of the Institute of British Foundrymen is to be held this year at Glasgow on June 10, 11 and 12.

The railway companies have agreed to issue tickets at the ordinary single fare and one-third for the double journey, fractions of 3d. reckoned as 3d., minimum adult fare 1s., to passengers travelling to attend the Convention, upon surrender at the time of booking of vouchers obtainable from the Hon. Secretary of the Convention Committee, Mr. John Bell, 60, St. Enoch Square, Glasgow. The tickets will be available from June 8 to June 13.

PROGRAMME.

Tuesday, June 9, 7.30 p.m.—On the invitation of of the Scottish Branch, members and ladies will be entertained to an "At Home" in the Grosvenor Restaurant, Gordon Street. Tea from 8 p.m. till 9 p.m.

Wednesday, June 10, 9.30 a.m.—Conference opens in the Lecture Hall of the Institution of Engineers and Shipbuilders in Scotland, Elmbank Crescent. Welcome by the Rt. Hon. the Lord Provost of Glasgow, Mr. M. W. Montgomery; Lord Invernairn; Colonel J. A. Roxburgh, President, Glasgow Chamber of Commerce; and Professor A. L. Mellanby, D.Sc., Royal Technical College, Glasgow.

10.30 a.m.—Ladies will visit places of interest in Glasgow or one of the following: (*a*) Art Galleries, Kelvingrove. (The art treasures of the Glasgow Corporation are world-famous, and Mr. T. C. F. Brotchie, the Curator, has kindly consented to conduct the party personally round the Galleries); (*b*) Messrs. Wallace, Scott & Company, Limited, clothing specialists, Cathcart. (The works of Messrs. Wallace, Scott & Company, Limited, are of special interest, being laid out on ideal lines, and ladies visiting the works are invited by the firm to remain for lunch at 1 p.m.); and (*c*) Messrs. Birrell, Limited, chocolate manufacturers, Anniesland.

Civic Reception, 3.0 p.m.—The Rt. Hon. the Lord Provost and Magistrates of Glasgow invite members and ladies to a Civic Reception in the City Chambers.

6.30 p.m.—Banquet in the Grand Hall, Grosvenor Restaurant, Gordon Street, for members and ladies. (Dress optional.) Tickets—single ticket, 7s. 6d.; combined ticket (lady and gentleman), 12s.

Thursday, June 11, 9.15 a.m. — Conference continues.

9.15 a.m.—Motor trip for ladies only to Drymen, via Bearsden and Stockiemuir, returning via Killearn and Strathblane.

11.59 a.m.—Members and ladies leave Glasgow (Charing Cross Station) for Larbert, arriving at 12.48 p.m. Return fare 2s. 6d. each.

1.30 p.m.—On the invitation of Messrs. The Carron Company and Messrs. The Falkirk Iron Company, Limited, members and ladies will be entertained to luncheon in the Dobbie Hall, Larbert.

2.30 p.m.—Members are invited to visit one of the following works: (*d*) Carron Company, Carron, and (*e*) Falkirk Iron Company, Limited, Falkirk. Both of the above firms have kindly promised to provide light refreshments.

2.30 p.m.—Ladies are invited to go to Stirling by motor to see this historic town and castle. Tea will be provided.

7.0 p.m.—The Provost and Magistrates of Falkirk invite members and ladies to a Civic Reception in the Town Hall.

8.54 p.m.—Members and ladies leave Falkirk (Grahamston Station) for Glasgow (Queen Street), arriving at 9.28 p.m

Friday, June 12, 10.0 a.m.—Members and ladies will sail by s.s. "Queen Empress" from Glasgow (Broomielaw), down the river, through the Kyles of Bute, round the Island of Bute, etc., returning to Glasgow about 6.30 p.m. (Tickets—single ticket, 7s. 6d.; combined ticket (lady and gentleman), 12s.). The party will be entertained to luncheon by the Reception Committee, and to tea by Messrs. Wm. Jacks & Company, Limited, iron merchants, 19, St. Vincent Place, Glasgow. For the convenience of those who must leave Glasgow early an invitation is given to visit one of the following works: (*f*) Babcock & Wilcox, Limited, Renfrew, and (*g*) G. & J. Weir, Limited, Cathcart.

The following papers are to be submitted to the Conference: (1) "Low Temperature Heat Treatment of Special Cast Irons," by J. W. Donaldson, B.Sc., A.I.C.; (2) "Malleable Iron," by F. H. Hurren; (3) "The Practical Application of Metallography in Bronze Founding," by F. W. Rowe; (4) "Aluminium Alloy Castings—Preparation, Treatment, Properties," by F. S. Archbutt; (5) "A Note upon the Practice and Purpose of Perlit Iron," by H. J. Young; (6) "The Present Status of our Knowledge of Sand Testing," by Dr. H. Ries (American Exchange Paper); and (7) "Heat Resisting Cast Iron," by Andre Levi, ingenieur chemiste (French Exchange Paper).

Souvenir Booklet and Badge. — A souvenir booklet, giving the programme in detail, and a badge will be supplied to each member and lady attending the Convention.

Clubs.—The following clubs will extend their hospitality to members of the Institute: The Conservative Club, the Liberal Club, and the Constitutional Club.

Motion of Electricity in Metals.

May Lecture to the Institute of Metals.

Last evening Professor H. A. Lorentz, of Haarlem, delivered the 15th Annual May Lecture before the Institute of Metals in London.

After some introductory remarks regarding the constitution of atoms, the number of electrons contained in a metal, and their state of motion in the atom, the lecturer considered the mean velocity of the electrons, when there was an electric current, and showed how Ohm's law could be understood without going into the details of the electronic motions. On the same general grounds an explanation was given of Tolman and Stewart's experiments, by which it was experimentally proved that an electric current in a metal consisted in a motion of negative electrons and the dynamical theory of electromagnetism, as set forth in Maxwell's Treatise, as applied to these experiments. The lecturer then proceeded to the discussion of Drude's theory of the conductivity for electricity and for heat, and of some questions connected with it, insisting on the manner in which the number of free electrons was limited by the value of the specific heat.

The remaining part of the lecture was devoted to the phenomenon of supra-conductivity discovered by Kamerlingh Onnes, and particularly to one of his later experiments, made with a suspended thin spherical shell of lead, in which a system of persisting parallel circular currents had been set up and which was placed in an external magnetic field whose direction did not coincide with the axis of the current system. It was shown that in these circumstances, if the electrons were absolutely free, the axis of the current system ought to have a precessional motion about the line of force passing through the centre. No trace of such a precession had, however, been observed. The conclusion was that, even in a supra-conductive metal, the electrons are not wholly free in their motion. It seemed as if definite paths were prescribed them, along which they could move without encountering a resistance, but which they could not freely leave sideways.

Machine Tool Castings.

Mr. Jowett points out that an error appeared in the discussion of his Paper. It reads, the mixture was one barrow of yellow sand, with one *barrow* of superfine coal dust. It should read, of course, one barrow of yellow sand, with one *bucket* of superfine coal dust.

The Travelling Bureau of Trade and Technical Journals opens its first tour at the Birmingham Chamber of Commerce on Monday, May 11, continuing there until May 15. The opening meeting will be addressed by representatives of trade, industry and journalism.

The Cogne-Girod Electric Steelworks, Aosta.

By Dr. Federico Giolitti.

The works acquired by the Cogne-Girod Electric Steelworks Company (formed in January, 1924) from the Ansaldo-Cogne Company had been planned by Messrs. Gio. Ansaldo & Company towards the end of 1916 for the purpose of manufacturing special steels (at that time much in demand for the construction of war material) by using the Cogne ore and the pig-iron obtained from it in electric high-shaft furnaces, which latter plant—on a site adjacent to the steelworks—was to be completed at the same time as the steelworks themselves.

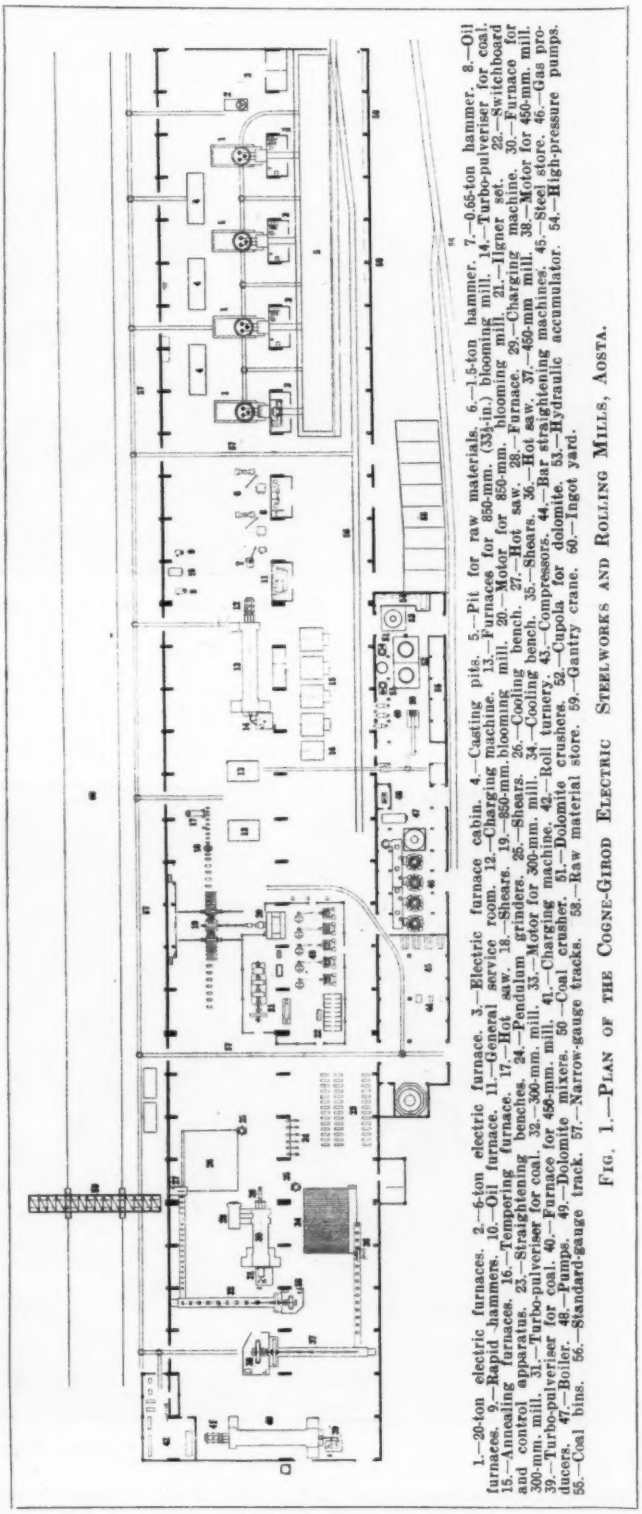
The serious difficulties which—for well-known reasons—stood in the way of rapid construction of industrial plants during the last two years of the war, were responsible for the fact that on the cessation of hostilities in the autumn of 1918, the Aosta works had not yet been completed. Meanwhile Messrs. Gio. Ansaldo & Company, modifying their first scheme in order to adapt it to the development of their extensive and complex industrial post-war activities, had decided to devote the Aosta steelworks to the manufacture of steel plates and sheets. With a view to this new scheme, the plant of the steelworks was constituted of the following main sections:—(1) Four Héroult furnaces of 25 tons; (2) one three-high 850 mm. (33½-in.) rolling mill, driven by an Ilgner set; (3) three gas-fired reheating furnaces; (4) one annealing furnace; (5) two shearing machines and two straightening machines, in addition to other auxiliary plant. The plant thus constituted worked for some time producing plates and sheets. It was then closed for a number of reasons which need not be gone into.

In the meantime the whole of the works owned by Messrs. Gio. Ansaldo & Company in the Aosta Valley had been acquired by the new Ansaldo-Cogne Company, who, in a short time, completed the Cogne iron-ore mines, and—after a first exhaustive experiment, lasting more than ten months, with the first electric high-shaft furnace—was able to proceed rapidly and on a sound basis with the construction of the plant for the systematic dressing of the ores (concentration and briquetting) and the completion of the group of electric high-shaft furnaces, as well as of various important auxiliary plants.

The rapid development of this combination of plants (electric power stations, a mine, an ore-dressing plant, electric furnaces and accessory plant, and plant for the manufacture of ferro-alloys) naturally rendered a speedy solution of the steelworks problem all the more necessary.

After a careful examination of the special conditions affecting the Aosta works, the conditions of the Italian and foreign markets for iron and steel, and the special demands which the Aosta group of works would have to satisfy in view of possible war requirements, the Ansaldo-Cogne Company decided to devote the new steelworks to the manufacture of special steels.

In order to avoid the serious difficulties, both technical and financial, which the Company would necessarily have had to encounter for many years to come, had it proposed to carry out such a programme merely with the aid of the extremely small technical staff available in Italy who were thorough experts in the manufacture of special steels and their successive stages of treatment (which staff, moreover, would have had to be taken from the few other Italian works at present producing ordinary and special steels, thus completely disorganising such works), the Ansaldo-Cogne Company con-



1.—20-ton electric furnaces. 2.—6-ton electric furnace cabin. 3.—Electric furnace cabin. 4.—Casting pits. 5.—Pit for raw materials. 6.—1.5-ton hammer. 7.—0.65-ton hammer. 8.—Oil furnaces. 9.—Rapid hammers. 10.—Oil furnace. 11.—General service room. 12.—Charging machine. 13.—Furnaces for 850-mm. (33½-in.) blooming mill. 14.—Turbo-pulveriser for coal. 15.—Annealing furnaces. 16.—Tempering furnace. 17.—Hot saw. 18.—Shears. 19.—850-mm. blooming mill. 20.—Motor for 850-mm. blooming mill. 21.—Ilgner set. 22.—Switchboard and control apparatus. 23.—Straightening benches. 24.—Pendulum grinders. 25.—Shears. 26.—Cooling bench. 27.—Hot saw. 28.—Furnace. 29.—Charging machine. 30.—Furnace for 300-mm. mill. 31.—Turbo-pulveriser for coal. 32.—300-mm. mill. 33.—Motor for 300-mm. mill. 34.—Cooling bench. 35.—Shears. 36.—Hot saw. 37.—450-mm. mill. 38.—Motor for 450-mm. mill. 39.—Turbo-pulveriser for coal. 40.—Furnace for 450-mm. mill. 41.—Charging machine. 42.—Roll turnery. 43.—Compressors. 44.—Bar straightening machines. 45.—Steel store. 46.—Gas producers. 47.—Boiler. 48.—Pumps. 49.—Dolomite mixers. 50.—Coal crusher. 51.—Dolomite crushers. 52.—Cupola for dolomite. 53.—Hydraulic accumulator. 54.—High-pressure pumps. 55.—Coal bins. 56.—Standard-gauge track. 57.—Narrow-gauge tracks. 58.—Raw material store. 59.—Gantry crane. 60.—Ingot yard.

FIG. 1.—PLAN OF THE COGNE-GIROD ELECTRIC STEELWORKS AND ROLLING MILLS, AOSTA.

cluded an agreement with M. Paul Girod, the well-known French engineer, for the purpose of securing not merely the co-operation of M. Girod himself, but also—what was of the utmost importance—that of the skilled staff who had collaborated with him for many years in the success of the electric steelworks at Aosta. Thus was formed in January, 1924, the Cogne-Girod Company, in which the Ansaldo-Cogne Company retained a large interest.

The new Company acquired the Aosta electrical steelworks from the Ansaldo-Cogne Company, and

FIG. 2.—GENERAL VIEW OF STEELWORKS.

metallurgical undertakings founded and directed by him.

M. Girod, after having studied the exceptionally favourable conditions under which the manufacture of special steels might be developed at Aosta, particularly owing to the availability of the made agreements with them for the supply of the necessary electric power. The Company was also to have ample supplies of Cogne ore and pig-iron. This latter material was to be supplied to the steelworks in the molten state. Unlike the few Italian steelworks which have hitherto produced

FIG. 3.—ELECTRIC FURNACE DEPARTMENT.

very pure Cogne ores and the high quality of pig-iron manufactured from them, did not hesitate to abandon completely the various French metallurgical undertakings which he had conducted until then with great success for over twenty years, in order to devote his time entirely to the special steels, the Cogne-Girod Works will not manufacture any common steel, but will devote themselves exclusively to the production of special steels.

The three principal processes which the Cogne-Girod Works will normally employ in the manu-

facture of the various kinds of special steel are as follows:—(1) Treatment of selected scrap, combined with the use of Cogne ore and pig-iron; (2) direct treatment of pig-iron with Cogne ore; (3) direct treatment of the ore in the steel furnace. A series of numerous casts, made during two months, had shown that the systematic employment of each of these three processes in the manufacture of particular kinds of steel enabled the superior quality of the two principal materials available at Aosta (namely, ore and pig-iron) to be turned to excellent advantage in the production of steels of a quality that only the best crucible steels could be compared with.

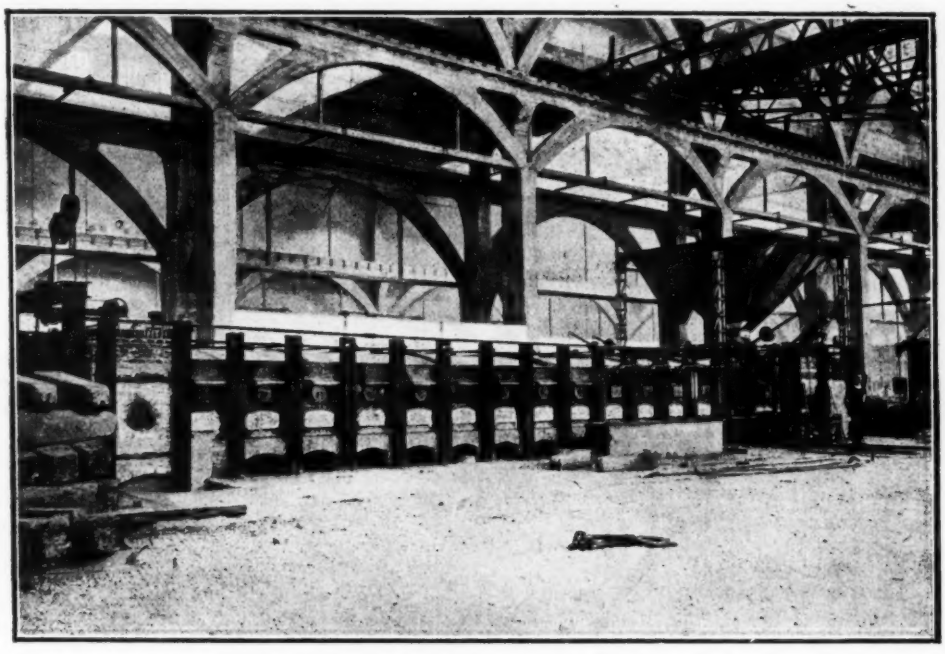


Fig. 4.—Heating Furnaces for Ingots.

The experience thus gained has confirmed the opinion that each of these three processes is specially suitable for producing a certain grade of steel. Thus the process referred to above under No. 2 is particularly suitable for the manufacture of certain very hard steels entirely free from brittleness, while the process under No. 3 is particularly suitable for the manufacture of extra-mild steels, which can be forged cold, with reductions of section equal to those generally obtained in hot-forging.

The arrangement of the new plants permits the ready adoption of duplex processes. To carry out their programme the Cogne-Girod Company has had to alter very considerably, and greatly to extend the existing plants of the Aosta steelworks. The most important of these alterations and the principal new plants may be briefly described as follows:—

Fig. 5.—View of 3,000-k.w. Ilgner Fly-wheel Set.

. *Electric Furnaces.*—The Héroult furnaces have been converted to a type devised by M. Paul Girod as being more suitable for the manufacture of special steels. The electrode holders have been made to form an integral part of the furnace body,

and their adjustment by hand has been replaced by a system of automatic hydraulic adjustment.

The four extant 25-ton furnaces have been supplemented by a 6-ton acid furnace of the Tagliaferri type, with lateral electrodes for heating the charge. This furnace will be specially devoted to steel manufacture by a basic-acid duplex process. Two 1-ton furnaces have also been installed; these are intended for experimental research and the manufacture of special steels required only in small quantities.

Rolling Mill.—This consists of (1) an 850-mm. (33½-in.) blooming mill. The three-high sheet mill has been converted into a two-high reversing mill with a complete system of roller conveyors and the necessary auxiliary plant. The billets are cut by a hot saw and by hydraulic shears. The mill is driven by an Ilgner set of 3,000 kw., the reversible motor being capable of developing an instantaneous power of 9,000 kw.

The heating of the ingots for this mill is done (according to the kinds of steel and ingots) in two gas-heated furnaces situated behind the rolling mill, and a continuous furnace fired with powdered coal—capable of heating 10 tons of ingots per hour.

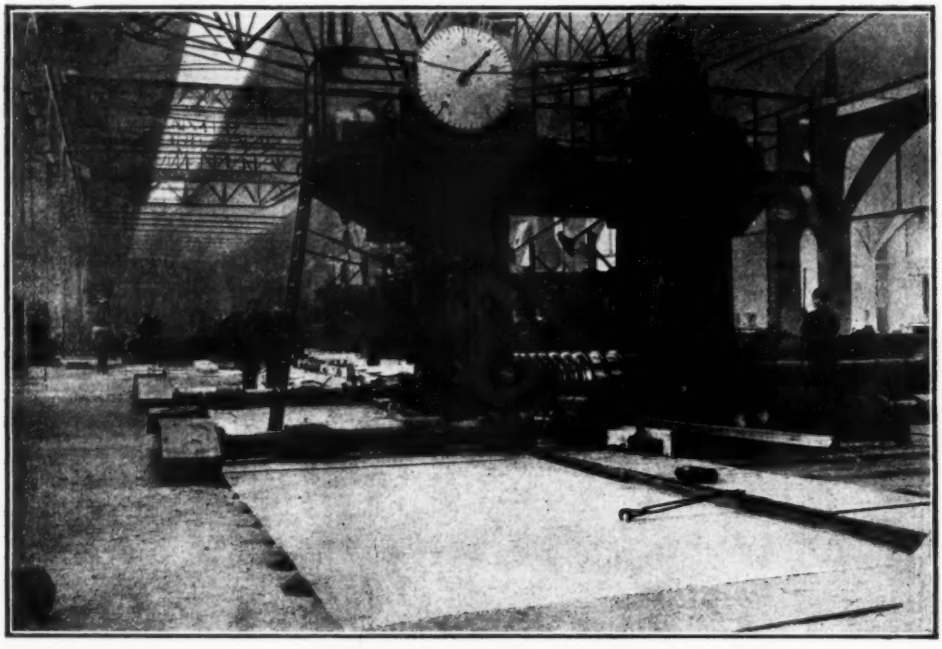


FIG. 6.—BLOOMING MILL.

(2) A three-high 450-mm. (18-in.) mill, with six stands and driven by a 650-kw. motor. It is fed with billets from the continuous furnace and is provided with a complete modern equipment (lifting gear, roller conveyors, hot saws, shears, etc.).

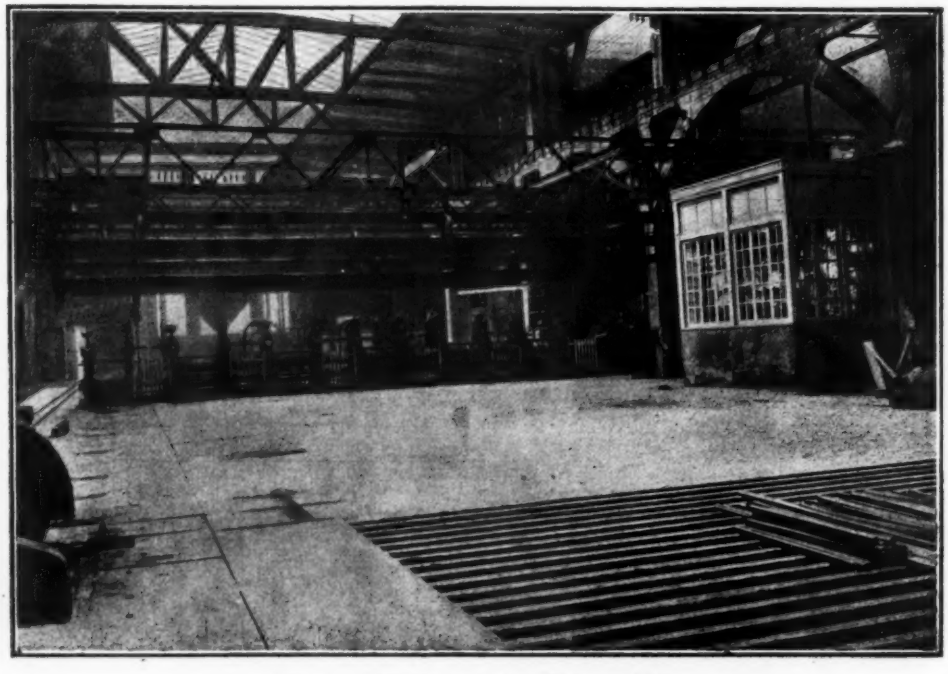


FIG. 7.—THREE-HIGH 18-IN. ROLLING MILL.

(3) A double two-high 300-mm. (12-in.) mill with seven stands, and driven by a 450-kw. motor. It is fed with billets heated in the continuous furnace and in a smaller furnace for heating steels requiring specially careful treatment. This mill also is fitted with a complete modern equipment for handling rolled material.

(4) A roll-turnery housed in a separate building adjacent to the large rolling mill.

Forge.—The equipment of this is at present limited to the forging of tool steels, particularly high-speed steels. The heating furnaces are fired with heavy oil. The plant consists of two 1½-ton hammers, one of 0.7 ton and two small quick-working hammers. The hammers are worked by compressed air supplied by a central compressor plant—with an aggregate capacity of 1,200 kw.—which also supplies the compressed air for the pneumatic tools.

Heat Treatment.—This section comprises four furnaces with wagon bottoms and one with fixed bottom. The five furnaces are fed by a battery of Kerpely gas producers.

Auxiliary Plants.—The four principal groups of plants described above are supplemented by a number of auxiliary plants expressly designed for the manufacture of special steels. In addition to these, and apart from the main building of the steelworks, there are other minor buildings containing the general stores, offices, etc.

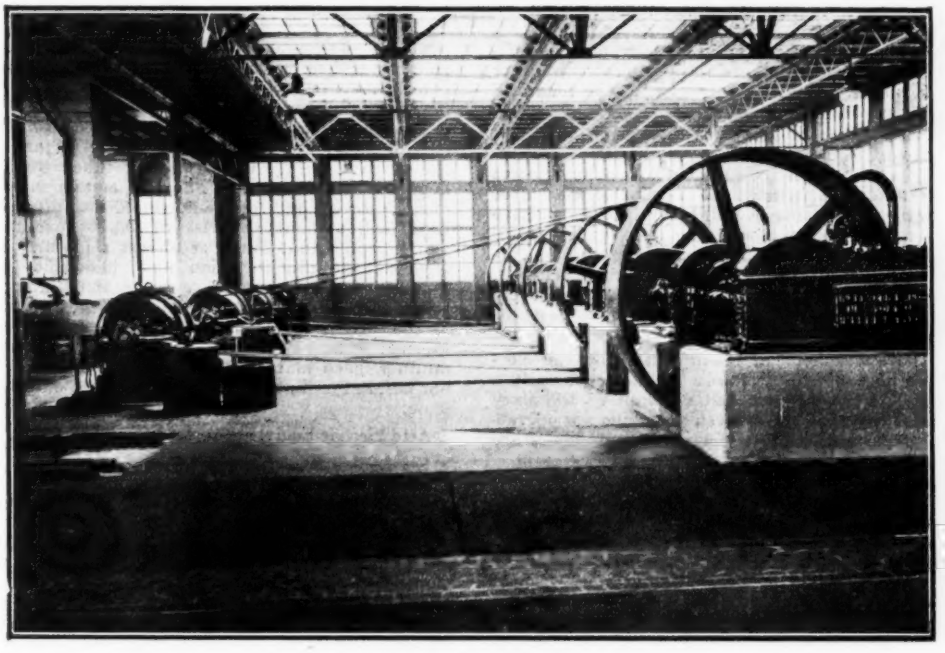


FIG. 8.—COMPRESSOR PLANT.

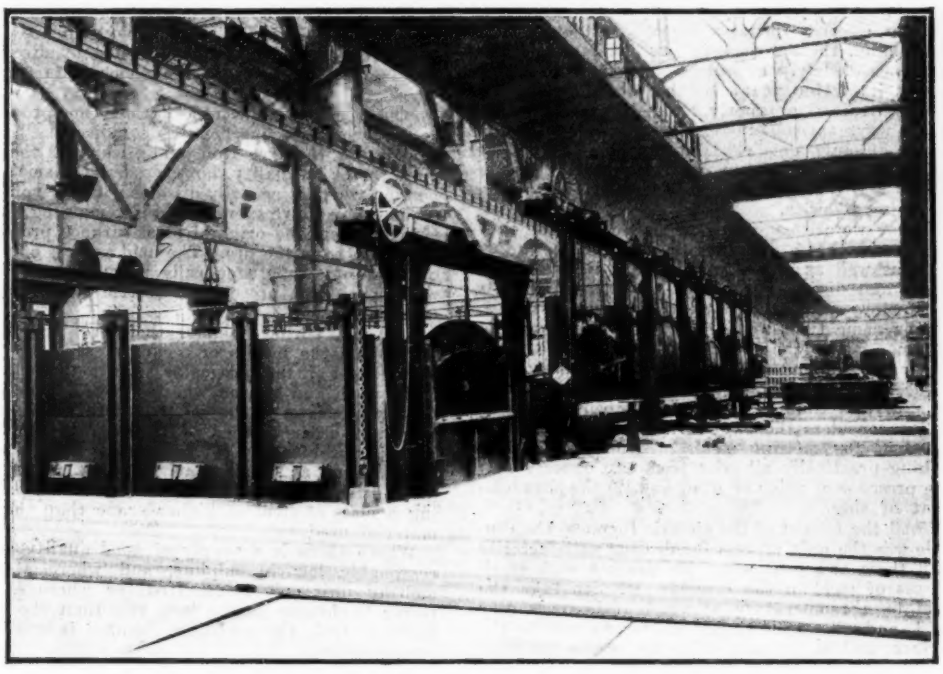


FIG. 9.—HEAT-TREATMENT FURNACES.

Maxims for Moulders.

Cleanliness is next to cleverness in moulding.—*Buchanan.*

If fins were only wings, some castings would need "slings," and "rings," and "things" to keep them in the foundry.—*Buchanan.*

Keep "soldiers" to the front, and well under cover.—*Buchanan.*

A bad moulder might make a good baker; if he continued to make bad ones he could be made to eat them.—*Buchanan.*

The Prospects of the Electric Furnace in Iron, Steel and Brass Foundries.*

By Harry Etchells, B.Met.

When invited to prepare a Paper on this subject the author felt those responsible were either leg pulling or were rare optimists, as the following two quotations show:—

"*Sheffield Daily Telegraph*," *April* 5, 1916.

"Special war needs and conditions have resulted in the number of Sheffield's electric furnaces being more than doubled; it is probable that after the war, these furnaces will enter into very active competition with the crucible, and crucible steel makers may have to adopt the newer type of furnace for the making of much of their output. Indeed, the electric furnace may yet rival the big blast furnace."

"*Yorkshire Post*," *January* 5, 1925.

"The experiment of making steel by the electric furnace appears to have been quite a failure in this district, as not half a dozen of the sixty furnaces installed six or seven years ago are operating. Some have been dismantled, and others are standing idle.

"Apparently, as a substitute for the crucible, the electric process is not considered to be suitable. It is, however, being used to an increasing extent in various places for producing steel castings, and is being installed in many distant lands where water is available for generating current. Bad trade may be partly responsible for the disuse of the electric furnace in Sheffield, as one of this type will produce at a single heat ten or even twenty times as much metal as a crucible."

If the electric furnace is to be considered dead, both good trade and bad trade have combined to kill it. It came into prominence in this country during the war, when much was promised, and much was expected. But it should be remembered that it needed the practical hand of Robert Mushet to complete the genius of Henry Bessemer, and in the same way it needed, and still needs the expert practical direction of a trained electric furnace operator to produce results out of the electric furnace.

When electric furnaces were laid down with lavish hand, these men were few and far between, and consequently the process has had to suffer during its latter years for the shortcomings of many untrained or poorly trained operators. Fiction always spreads faster than fact, but fortunately if only one electric furnace installation makes good, the fact must ultimately become known, and there is no reasonable excuse for others not doing likewise.

To-day we are beginning to realise that the electric furnace has a definite rôle in our home industries, as well as in the world's varied metallurgy. We cannot discuss it off-hand by saying that it is satisfactory where hydro-electric power is cheap. At the same time we cannot make the sweeping statement that the electric furnace is the ideal melting instrument for all and every purpose.

The steel industry has developed the electric furnace in this country, and as a steelmaker, the author considers the electric furnace the ideal instrument for melting steel. Troubles in steelmaking practically all arise from two causes:—(1) The presence of oxide of iron, and (2) the entanglement of slag.

Until the advent of the electric furnace, the crucible was the only process for dealing satisfactorily with these two problems. By dealing with small masses of steel in the crucible, we can take the steel to a temperature at which it becomes very fluid, and allows all slaggy matter to rise to the surface, and at the same time we expose the steel to the influence of an atmosphere of carbon monoxide, which tends to assist the action of such deoxidisers as may be used.

In the basic-lined electric steel furnace, the steel is covered by a slag, which is actively deoxidising largely owing to the action of carbon in reducing silicon from the slag. The same slag is also a powerful desulphuriser, and by adopting a previous treatment with an oxidising basic slag, phosphorus may be removed down to very low limits, if there is any virtue in so doing.

The casting temperature is under very complete control up to the limit, set by the refractories of the furnace lining, which may be taken at 1,700 deg. C. The regular alloying metals such as nickel, chromium, tungsten, vanadium, etc., may be added, without any risk of loss by oxidation, and a really fluid sound steel cast singularly free from non-metallic inclusion and blow-holes produced. In this manner are made many kinds of complex alloy steels for forging, and the flexibility of the process is such that apart from the exothermal principle of reduction with agents like aluminium, such materials as "rustless iron" could not be produced at all, and certainly not on a large scale.

Acid Electric Equivalent to Acid Open-hearth Steel.

Electric steel has also set a new standard of attainment for steels like nickel, chromium and chrome vanadium. Although most of the specifications are drawn to take in open-hearth steels, the electric steel well made, can give higher figures than the open-hearth steel for maximum stress, elongation and impact every time. These features are worth remembering when dealing with the constructional material for motor cars and aeroplanes. In speaking of electric steel, only steel produced on a basic lining is referred to. The author recognises little distinction between electrically-melted steel on an acid lining, and acid open-hearth steel. The refining and deoxidising action of a basic lined furnace is due to having a lining of dolomite or magnesite, or both, which enables the steel to be taken to a high temperature combined with a slag of lime and silica covered by powdered carbon and impregnated with fluorspar, which has a definite deoxidising action.

In the acid-lined furnace the temperature is governed entirely by the limit of the melting point of the silicon lining. There is no evidence of intense deoxidising action by the slag by direct reduction, although, as in the Siemens-Martin furnace, the siliceous slag has a property of taking up the free iron oxide into solution, thus producing a steel which is superficially deoxidised.

It is not the free iron oxide, which is the ultimate factor in quality, however, but the small proportion which is actually dissolved in the iron, and which may have persisted in remaining, right through from the original blast furnace process of reduction from the ore. The acid process offers no evidence of strong chemically reducing conditions, while the basic process of electric melting offers every evidence.

The acid furnace should therefore be judged strictly on the merits of economy, which it offers in fuel cost in the particular situation where it is to be used, and also on whether it will handle the particular scrap to be melted more conveniently than any other method of melting. It should be judged purely as an alternative method of melting, and not as an alternative process which offers possibilities for refining base materials or producing a class of steel of higher grade than the raw material used.

Where there is a supply of good quality scrap, reasonably low in sulphur, and where a small melting unit only is required, or where electric power is cheaper in the long run than the other forms of fuel, the acid-lined furnace is worthy of consideration.

Basic electric steel has given a remarkably good account of itself in the steel foundry. Mild steel castings may be produced with very low carbon-contents if required, and in the cast state the steel shows remarkable ductility, which is reflected in its freedom from hot cracks and tears.

The steel is so well deoxidised that it is often judged as sluggish compared to, say, converted steel. This offers no difficulty in pouring intricate

* A Paper read before the London Branch of the Institute of British Foundrymen, Mr. V. C. Faulkner, presiding.

castings if the metal is super-heated accordingly, but the moulds should be strengthened to meet the higher temperature of the metal, and suitable provision made for its greater contraction on cooling.

Temper for temper, basic electric steel always gives a higher yield stress, a higher maximum stress and greater ductility than a comparable converted or open-hearth steel. This is very apparent in the "as cast" condition, and for many purposes mild electric steel castings may be put to use "as cast." The coarse casting structure is there, however, and it is much better to remove it, but the great weakness of sulphide and other non-metallic inclusions along the crystal boundaries is not to be feared as in open-hearth steels.

For steel foundry work the basic furnace may consume from 800 units per ton on a 3-ton furnace to 1,000 units per ton on a ½-ton furnace, working days only. Power is the big cost in melting steel electrically, and we cannot hope for any large development in this country until the cost of power is more comparable to that of other countries. Electrodes form another substantial item of cost. Whether graphite or carbon electrodes are used, the costs are very much the same for consumption, but graphite electrodes introduce economies in handling. If we had cheaper power we should be particularly well situated for making electrodes in this country, and so cheap power would effect a twofold economy. To-day the quality of electric steel castings is well established, and we only await the electrical-supply authorities to do their part in enabling us to meet the severe competition which is coming from Italy, France and U.S.A. These countries are in a position to make electric steel at the price at which we supply open-hearth and converter steel.

When once a consumer has handled properly made basic steel casting, it will require a considerable difference in price to tempt him to have any other.

The Iron Foundry.

Many reports have been coming to us over the last three years of the progress of the electric furnace as applied to iron founding in U.S.A. In judging these we should remember that the States vary extremely in their costs of fuel and refractories for different localities. The Eastern States are well supplied with coal and coke, and their electric power costs are often comparable to ours, but westward there is a region of cheap electric power, where coal and coke are only obtainable at great expense. Hardly any civilised community, however small, can get along without an iron foundry, and thus the electric furnace has come as a salvation to the Western States. Iron founding over here has been developed to such a pitch that the ultimate consideration must be made on comparative costs.

To melt pig-iron in the electric furnace consumes something like 600 kw.-hrs. per ton of electric energy. Power at ¼d. per unit would hardly enable the electric furnace to compete with the cupola. For the majority of purposes the product of the cupola does not need improvement, but there are a few types of castings, where an improved iron would be worth considering, such as, for instance, steam and automobile cylinder castings, piston rings and Diesel engine castings.

The basic electric furnace deoxidises and desulphurises iron melted or treated in it. In addition the metal may be super-heated for intricate work, and it will also be notably free from non-metallic inclusions. The product again is a dense close-grained iron, with a high contraction co-efficient, and in some foundries such an iron would possibly not be welcome. It is remarkable what a difference in physical properties is made by passing an iron through the electric furnace. A grey iron of 12 tons tensile originally will jump up to 22 tons per sq. in. Iron melted in electric furnace casts with a small grain-size. The author has cast air-cooled engine cylinders in which the fins were particularly light. The castings were not brittle, and when a fracture was obtained it was of a singular velvety appearance, showing complete uniformity all over.

It is possible to make white or grey iron in the electric furnace. The author has at times produced white iron, low in sulphur and phosphorus by starting originally with steel scrap. This synthetic iron has been used quite satisfactorily by steel makers as a substitute for Swedish white iron. Since dephosphorisation is not possible, and, in fact, not desirable in iron foundry practice, there is usually no object in melting pig-iron in the electric furnace. It is more economical to follow a duplexing process and draw liquid metal from the cupola.

All the advantages of deoxidation and desulphurisation can then be carried out with an expenditure of about 200 kw.-hrs. per ton in the electric furnace.

Melting raw pig-iron offers peculiar difficulties, as the pigs are generally coated with sand and scale, which insulate the metal, and the author remembers the perspiring time he had when he first essayed to melt pig-iron, until he realised what was amiss. The acid-lined furnace has a very limited scope in the iron foundry. It will work a little faster, if borings and scrap are melted from the cold, and it is possible to superheat the metal, but no refining can be done apart giving a clean metal.

There is always a drop in carbon in passing pig-iron through the electric furnace. The usual cupola metal will lose from 0.25 to 0.40 per cent., and it is impossible to replace this. Electrically-treated iron is in many ways akin to semi-steel. From the foregoing brief remarks it will be seen that the electric furnace can be particularly useful in foundries which have rigid specifications to meet, and especially in foundries which cater for mixed work in iron and steel.

While normally working on steel castings occasional heats may be drawn from the cupola and specially refined iron castings produced. It is thought that more use may be made of alloy additions both in steel and iron foundries. Nickel and vanadium would considerably improve the metal for many purposes, and the electric furnace offers the best means of making such additions effective. The wider use of the electric furnace must to a large extent depend upon bringing down the cost of power.

There are very few lines in iron castings which would stand another £2 per ton in melting charges for refining the metal after it has passed through the cupola. The prospects, therefore, in the iron foundry are extremely limited.

Brass and Non-Ferrous Alloys.

Considerable interest is now being shown in electric furnaces for melting the brasses and non-ferrous alloys. Furnaces have developed in the United States where conditions were particularly favourable to them. It is estimated that there are about 540 furnaces in use, of which 140 have been installed over the last two years. In non-ferrous work the question of chemical refining does not enter to any great extent. The parts which come into prominence are economies in melting and losses by volatilisation and residues. Several types of furnace are doing useful work in the non-ferrous field. These are induction, arc and radiant resister types. In dealing with non-ferrous metal, each type of furnace has its peculiar application. In the designs of electric furnaces the guarding against heat losses is always before the designer's mind, and his aim is to get the source of heat as near the metal as practicable.

A study of steel and ironfoundry practice shows that the results of evolution in design is a furnace of comparatively simple construction, in which the arc is the source of heat, but in which it actually makes contact with the charge. This type of furnace has a very limited application in the non-ferrous industry; it is used for cupro-nickel monel metal, and for the nickel chromium alloys with success, but for the brasses and bronzes which constitute the greater part of the non-ferrous industry it is quite unsuitable. For alloys containing volatile metals the maximum temperature near the metal must be strictly limited, and to obtain maximum efficiency the heat must be distributed as evenly as possible over the metal. The induction type of furnace in which the metallic charge is the

secondary of a transformer system therefore appeals strongly on theoretical grounds. To construct this type of furnace at a cost comparable with other types requires an iron yoke and iron winding, and the receptacle for the charge to be in the form of a closed loop.

The large currents induced cause "pinching" of the metal if a horizontal bath is used, and the difficulty has been ingeniously got over by using a vertically-shaped loop, closed by a metal reservoir at the top, so that the hydraulic pressure of the metal itself tends to counteract "pinching." In an induction furnace the metal is in constant circulation, which causes some considerable wear on the lining.

A complete ring of metal must always be kept in the crucible, or else a liquid charge poured in to keep a closed secondary circuit. If the metal is allowed to solidify it will crush the lining.

With these limitations the induction furnace has been found very economical in continuous working on yellow brass, and similar low-melting-point alloys. For continuous working the power consumption is 200 to 250 kw.-hrs. per ton of metal. The radiation resistance furnace has been used many years. In this furnace a granular resister is contained in a trough, and the trough attached to the inner walls of the furnace. When heated up the heat is thrown on the roof and then reflected down on the metal contained in a bath.

It will readily be appreciated that very heavy lagging is required to prevent heat losses through roof and walls, and, consequently, the whole mass of the furnace must be heated up before it begins to melt the metal. Once the furnace is hot it works with great regularity, and in half-ton units appears to consume about 350 units per ton of red brass. The lining will deal satisfactorily with higher temperatures than are advisable in the induction furnace.

It did not appear as if the arc furnace with its low capital cost and the simple mechanism would be able to render service in the non-ferrous alloy field until somebody conceived the idea of rotating the furnace so as to obtain heat distribution. Out of the 540 furnaces mentioned 135 are stated to be of the indirect arc type.

These furnaces are generally constructed to maintain a free burning arc between electrodes which enter through the ends of the furnace body. A transformer is needed to give a low-tension arc, and by employing three electrodes three-phase current may be used.

This type of furnace is perhaps the most flexible of all the types used for non-ferrous work. It is heated up very quickly, and can be emptied of every charge completely, thus enabling a change of alloy to be employed if required. In a furnace of, say, 2 cwt. capacity the power consumption appears to be about 250 kw.-hrs. per ton for yellow brass, and about 350 kw.-hrs. per ton for bronzes, with 80 to 90 per cent. copper. The electrode consumption is 6½ lbs. per ton.

These figures, it will be perceived, are economical, and this type of furnace can deal with high-melting-point alloys such as nickel silver, coinage metal, and has even been used for melting iron. In using the electric furnace for non-ferrous alloys no great claim can be made for improvement in physical properties, although slightly higher tensile figures are often obtained over coke-melted metal.

The total melting charges come down in the neighbourhood of £2 to £3 per ton for brass, and the metal losses in all types of furnace appear to be in the neighbourhood of 0.30 to 0.60 per cent.

Although the fuel costs are higher, it is open to serious consideration whether the handling of metal in greater bulk would not effect economy in many brass foundries, and there is real hope for the wider adoption of electric melting in this particular industry.

There still remains scope for the introduction of a small flexible and economical melting unit for non-ferrous alloys, which will enable the non-ferrous caster to deal with small bulk and varying demand.

A furnace which enables metals of all melting-points to be dealt with in crucibles free from contamination, and, if need be, *in vacuo*, is that invented by Dr. F. Northrop. In this furnace the crucible containing the charge is placed in the centre of a high-frequency inductive field, and one may truly say that the energy is "wirelessed" to the charge.

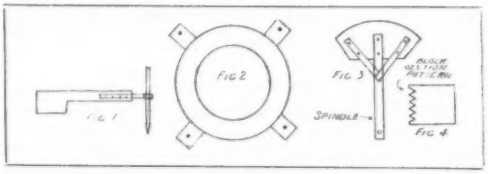
The equipment is necessarily very expensive to obtain frequencies of 5,000 cycles and upwards, but a furnace of 100 kws. has been constructed to melt up to 600 lbs. of copper in one charge, and there appears to be hope that what at first looks like a laboratory proposition may be ultimately perfected into a simple and practical large-scale melting instrument.

Moulding a Rope Pulley.

BY W. HOLLAND.

This article describes a method of making rope pulleys to eliminate the joints in the grooves and so making the pulley easier to machine. A hole is dug to the required depth and size, a spindle is plumbed up in the centre of the hole. Next a seating board is bolted on to the loose arm that goes over the spindle, as in Fig. 1. The seating is now struck up either in loam or sand, 3 in. larger than the required size of the grooved pulley. A cope ring is made rather larger than the seating, care to be taken to allow for contraction, also the ring to be wide enough to counterbalance the weight of sand and irons in the grooves, as in Fig. 2.

The ring is bedded over the seating, care being taken that it is bedded solidly. The groove pattern required is an exact section of the grooves with a strip pegged on to the pattern, and also having a spindle hole as is shown in Figs. 3 and 4. The pattern is now placed into position for ramming the grooves, great care being taken when



ironing and venting the grooves. After a section of the grooves is rammed up the pegs are removed from the strip, thus making the pattern free to be drawn out and set into position for ramming the next section, after, however, replacing the pegs through the strip into the pattern.

When the grooves are completed the cope ring is stacked so as to ensure the ring going back in its proper position, as it will be necessary to lift the cope ring to blackwash and dry the grooves. The arm cores are now placed into position on the bed and the grooves lowered back again over the arm cores on to the seating.

A flat-loamed plate with the necessary runners and risers through is then placed over the cores and grooves. The complete mould is then weighted or bolted down, according to the practice followed in the foundry where the castings are made.

Another method is to set the groove cores into position and strike over them with a loam board, thus making up all the joints and ensuring a true groove. These methods ensure a truly balanced rope pulley.

Patent Specifications.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of Lonsdale Chambers, 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

LEWIS, N. Foundry moulding machines. No. 231,248.

LEWIS, N. Roll-over pattern drawing moulding machines. No. 231,249.

FERTIGGUSS-UND METALLWERK AKT GES. Die casting machines. No. 217,929.

BAILY, T. F. Electric furnaces. No. 221,206.

BOSSHARDT, E. Open-hearth furnaces. No. 223,870.

Gates and Risers.*

By F. C. Edwards.

(*Continued from page* 368.)

Stepped Downgates.

In gating deep moulds it is advisable to form the downgate by steps, after the manner shown in Fig. 12. The upper section of the gate is arranged so as not to come directly over the next lower section, but, say, several inches to one side of it. By breaking the fall of the metal in this way there is less likelihood of the formation of hard shots, or of the digging up of the mould at the bottom of the gate. In order to break up the scum crust on the rising metal it is usual to employ several pouring gates in the same gate box. These gates are separately plugged at the commencement of pouring. When the basin is nearly full, the plug leading to the lowest ingate is withdrawn. And, as the metal rises in the

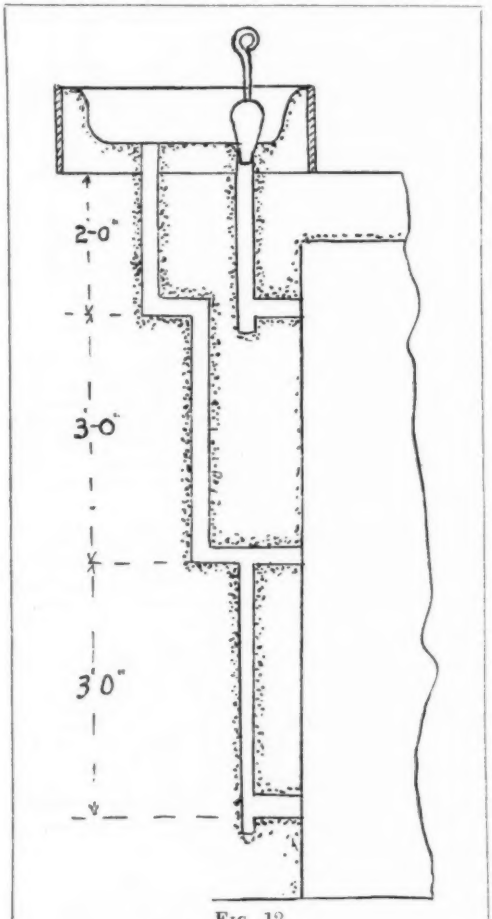


FIG. 12.

mould, the other plugs, in their order of ascent, are successively drawn. In this way fresh hot metal is introduced at increasing heights.

Skimming Gates.

Skimming gates are employed to trap scum which would otherwise enter the mould. They are formed upon two main principles—specific gravity and centrifugal force. In the case of specific gravity, the exterior portion of the pouring gate is made of a much larger area than would be necessary if it were employed merely as a pouring gate. Its function is, then, that of a reservoir, from which the mould is supplied with clean metal. The interior portion of the gate—the passage leading to the mould—is no larger than would ordinarily be required. The supply of metal being greater than the demand, therefore, the lighter scum is given time to ascend to the top of the gate, whilst the heavier, *i.e.*, the cleaner, metal passes on to the mould. An example of the gravity form of skimming gate is shown at F, Fig. 5.

The principle of centrifugal force may be applied by forming a spherical chamber between the mould and the pouring gate, the chamber being suitably connected to each by sprues. The sprue

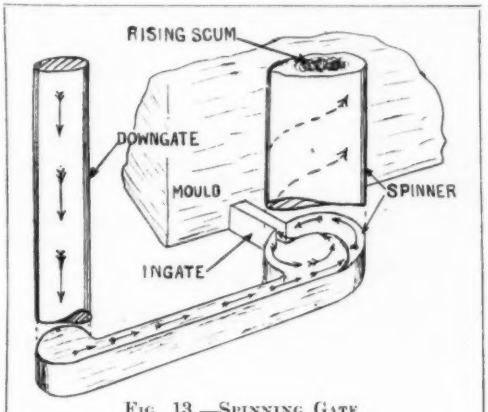


FIG. 13.—SPINNING GATE.

from the pouring gate is led into the chamber at a tangent to the outer edge. The sprue to the mould is taken out radially from the axis. The rotary motion which is thus given to the incoming metal causes the heavier (clean) metal to fly to the outside of the spherical cavity, and from thence into the radial sprue leading to the mould. The sprue to the mould should be placed at the back of the pouring-gate sprue. This ensures that the metal is given at least one turn round the sphere before it can enter the mould. The lighter scum is thus trapped in the centre of the skimming gate.

Another kind of skimming gate, formed on the centrifugal force principle, is seen in Fig. 13. Here a cylindrical "spinner," about twice the diameter of that of the pouring gate, effectually traps any dross *en route* to the mould.

Risers.

A riser is an air gate, or opening placed at the highest point of a mould to facilitate the escape of gas and dross as the metal fills the mould. In

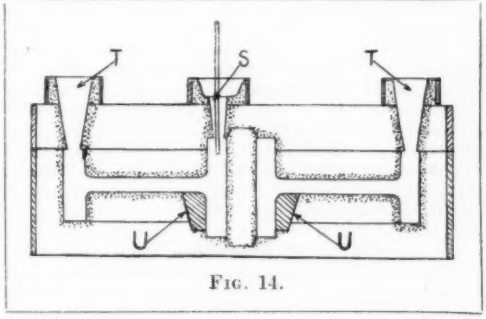


FIG. 14.

this way it prevents the straining of the mould and the formation of blow holes in the casting. Incidentally, it indicates when the mould is full. The sectional area of the riser should be greater than that of the runner gate. The riser box should also be deeper than the pouring basin.

An example of the employment of risers is shown in Fig. 14. These castings are machined all over. Originally they were gated in the web (the boss being considered rather small for this purpose). When the castings were machined, however, about 30 per cent. were rejected on

* A Paper read before the Sheffield Branch of the Institute of British Foundrymen, Dr. Desch, F.R.S., presiding.

account of dirt in the rim. Finally, the castings were obtained perfectly clean by gating at the boss, as at S, and placing two risers (T) at opposite points of the rim. The employment of denseners (U) was found necessary in order to obviate "drawing" in the fillet where the bottom boss adjoins the plate.

In green-sand moulds—particularly where the upper internal surface of the cope is exposed to the heat of the rising metal—the riser should be stoppered down. This is effected by placing, say, a piece of paper or an iron plate over the aperture and adding a suitable weight, such as a ball of sand or a brick. The weight is removed as the metal ascends the neck of the riser. If the riser is not stoppered, or if the weight is inadvertently removed before the mould is full, the top of the mould is likely to fall in, *i.e.*, to peel off in patches, and the result will be a scabbed casting.

The explanation would appear to be as follows:—In a green-sand mould with a flat upper surface the suspension of the sand below the box bars depends upon the mutual cohesion existing between it and the sand that is tightly wedged between the box bars. This cohesive power of the sand is largely a function of its moisture content. Now, when the ceiling of a mould is subjected to the fierce desiccating heat of molten metal immediately below, it rapidly becomes denuded of its moisture. As a consequence, there is a general shrinkage of the surface layer, *i.e.*, the thin stratum hanging below the bars. There would be a tendency for this layer to peel off.

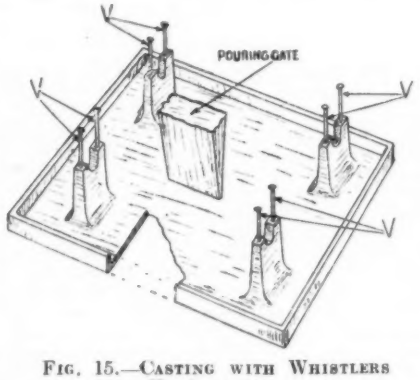


FIG. 15.—CASTING WITH WHISTLERS (V) ATTACHED.

And, in the absence of other sustaining forces, patches of the mould become loosened and may fall away owing to the influence of gravity.

A counteracting force, however, is normally available. The rapid displacement of air in the mould by the entry of the metal—in addition to gases carried into the mould along with the metal—and the evolution of immense volumes of gas by the action of the molten metal on the combustible constituents of the mould, sets up an internal pressure which is usually sufficient to neutralise the influence of gravity. The stopped riser may be regarded, therefore, as a kind of safety valve, which must be loaded sufficiently to prevent the easy exit of gas through the top part before the mould is filled with metal.

Whistlers.

The smallest risers are commonly referred to as "whistlers"—from the hissing sound which usually accompanies the exit of gas under pressure as the job is being poured. Examples of these diminutive, but very useful, risers are shown in Fig. 15. Here the whistlers (V) are shown on the casting as it is taken from the mould. The job is cast with the bearings upwards, in order to ensure a perfectly clean surface on the plate. The moulder forms the whistler apertures by pushing a large vent wire right through the cope at the highest points. This prevents the formation of gas pockets, and thus secures sound bearings. If the top edges of the casting from which the whistlers project are very thin, a small cleaner (say, $\frac{1}{16}$ in.) is used to pierce the cope.

Feeding Heads.

At the other extreme we have the massive feeding heads, as employed on large cylinders, rolls, etc. The head serves as a reservoir of metal upon which the casting may draw to make up for liquid shrinkage. The diameter of the head should increase from that of the casting upwards. The depth varies with the job, and may be from 3 in.

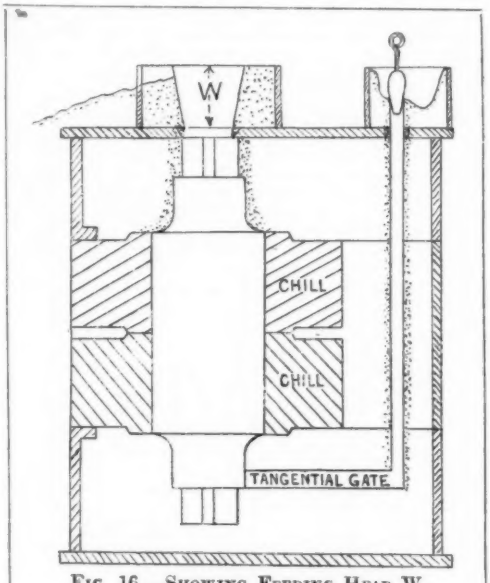


FIG. 16.—SHOWING FEEDING HEAD W.

to 12 in., or more. In the "feeding" of a chilled roll, for instance, such as that shown in Fig. 16—which may occupy a dozen hours of continuous work—the choked up head mould (W) is from time to time replaced by a new one. These head moulds are usually made in loam. Incidentally, a small cupola is generally employed to keep up the supply of hot, fresh metal.

How Gating May Cause or Correct Camber.

Incorrect location of gates sometimes produces camber troubles in an otherwise well-proportioned casting. Conversely, castings that are inclined to warp may be kept true by suitably arranging the gates. An example is shown in Fig. 17. The pattern for this light, narrow frame was made straight. The job was gated at the end, as shown dotted at X. The castings came out rather badly cambered. The flange side being hollow, of course. By gating at the side with several sprues, as at Y, instead of at the end, and by employing "dummy" sprues on the opposite side, as at Z, perfectly straight castings were obtained. The method, of course, is

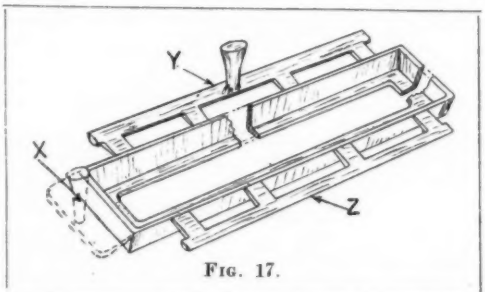


FIG. 17.

admittedly wasteful, and would only be employed for a few castings, or where time precluded the preparation of a metal pattern with the sides cambered just sufficiently to bring the casting straight. The case, however, strikingly illustrates the importance of correctly positioning the gates to suit the job. It also indicates how the gate may be instrumental in setting up or in nullifying contraction stress according to its location. The gate imparts heat to that region of the casting to which it is connected. Such heat may be utilised

to correct the effect of differing metal sections in a casting of uneven design. By placing the gate on the thinner section a more uniform rate of cooling is induced throughout the casting, which tends to eliminate the possibility of contraction stress.

From the foregoing examples it will easily be realised how indispensable is the study of gates and risers to those who desire to become *au fait* in foundry technique. The young student will find that this branch of his curriculum teems with interest, and that just as the gate leads the metal to the mould, so will a clear understanding of its functions and potentialities pave the way to a sound grasp of foundry phenomena in general. Then the moulder, by acquiring clear views on the subject, will be enabled the better to anticipate his share of that large percentage of scrap for which bad gating is notoriously responsible; he will find, by acting on the sound old maxim that "prevention is better than cure," that his pay envelope will insensibly grow, whilst the occasions for cursing his ill-luck will increasingly diminish.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

The annual general meeting of the Newcastle Branch of the Institute of British Foundrymen took place in the Neville Hall, Newcastle-on-Tyne, on Saturday, April 25, 1925, Mr. J. W. Frier (retiring President) in the chair.

Annual Report.

The report of the President and Council for the session 1924-25 was adopted. It was stated therein that during the session there had been seven meetings, the average attendance being 75.

The Branch has now a total membership of 238, an increase of eight since the previous report. Eighteen new members have been elected, losses by resignation and transfers to other Branches numbering 10. The detailed membership is as follows:—Subscribing firms 10, members 69, Associate members 84, and Associates 75.

The annual dinner of the Branch was held in the Grand Assembly Rooms on January 24, and was attended by over 100 members, ladies and friends.

Election of Officers.

On the motion of Mr. J. W. Frier, and seconded by Mr. James Smith, Mr. M. B. Herbst was unanimously elected President of the Newcastle Branch for the coming session. Mr. Herbst thanked the members for the honour which they had accorded him, and expressed the hope that, with their support and assistance, he would be able to carry out his year of office successfully.

Mr. E. Wood was appointed Senior Vice-President, and, in proposing his election, Mr. R. O. Patterson said he felt sure that Mr. Wood would make a Senior Vice-President of whom the Branch would be proud, and he personally was looking forward to the day when Mr. Wood would become President. Mr. W. J. Paulin seconded the motion, and in reply Mr. Wood said he would do his best to back up their President and see that the forthcoming session was one of the best on record.

In proposing Mr. Victor Stobie as Junior Vice-President, Mr. H. J. Young reminded the members that the success of the Newcastle Convention was, to a very great extent, due to Mr. Stobie's valuable work in that direction. He thought that the people who were to become Presidents of the Branches were those who would either make or unmake the Institute, and therefore the selection of Vice-Presidents should be very carefully made. He had fully considered the matter himself, and, in bringing forward Mr. Stobie's name, he felt sure that the Branch could not make a better choice. The proposal was seconded by Mr. A. Logan and carried unanimously.

Mr. H. F. Parsons and Mr. C. Gresty were re-elected Hon. Treasurer and Hon. Secretary respectively, whilst other appointments were:—Members of Council (by ballot), Messrs. T. McPherson and A. Logan; delegates to the General Council, Messrs. J. W. Frier, J. N. Simm and H. J. Young; reception officers, Messrs. J. V. Elliott and S. E. Smith; and lanternist, Mr. F. C. Spencer.

Presidential Address.

Mr. M. B. Herbst then delivered his Presidential address, taking for his subject "Mechanical Engineering."

Vote of Thanks.

In proposing a vote of thanks to Mr. Herbst, Mr. Paulin said that they all very much appreciated the amount of labour which was entailed in getting together an address of that nature, and that they must congratulate Mr. Herbst on his having dealt with such a large sphere of work.

Mr. M. E. Gallon seconded the motion, which was accorded with acclamation, and Mr. Herbst made a brief reply.

Vote of Thanks to Retiring Officers.

Mr. Gallon was the proposer of a vote of thanks to Mr. Frier and his officers for the valuable work which they had done throughout the year. He thought that probably it had been the best year they had had. He personally had thoroughly enjoyed all the meetings, and had found them most instructive and helpful.

In reply, Mr. Frier thanked Mr. Gallon for his kind remarks, saying that his year of office would always stand out as an episode in his life, because altogether it had been a very happy year for him. He was exceedingly grateful to his officers for their support and assistance.

The meeting then closed.

NEWCASTLE JUNIOR SECTION.

The annual general meeting of the Newcastle Junior Section was held in the Neville Hall, Newcastle-on-Tyne, on April 18, Mr. E. J. Rang, B.Sc., presiding.

The annual report of the President and Council for the session 1924-25 stated that five meetings had been held during the session, whilst visits had been paid to the following works:—Messrs. Younger & Gallon, Dunston-on-Tyne; Messrs. R. and W. Hawthorn Leslie & Company, Limited, St. Peter's; and Messrs. Sir W. G. Armstrong, Whitworth & Company, Limited, Close Works, Gateshead-on-Tyne. Also a successful smoking concert was held on December 12, 1924.

Mr. W. P. Gospel recently resigned the position of hon. secretary in consequence of his having taken up an appointment in London, and the President and Council desire to place on record their appreciation of his valuable services.

Election of Officers.

Mr. J. E. O. Little was unanimously elected President, whilst Mr. L. B. Chapman was appointed Senior Vice-President, Mr. F. Bowden Junior Vice-President, and Mr. C. R. Van der Ben Hon. Secretary. Elections to the Council were Messrs. T. P. Farral, C. Dodd, V. L. Banks, C. Boudry, F. C. Spencer, C. N. Rollin, and Elston.

Following the election of officers, Mr. L. B. Chapman read a Paper entitled "The Treatment of Coal for Industrial Use," which was illustrated by lantern slides.

An interesting discussion followed, the speakers being Messrs. E. J. Rang, C. Boudry, C. Dodd, J. E. O. Little, and C. R. Van der Ben.

After the lecturer had fully replied to all the questions raised, he was accorded a vote of thanks for his Paper.

Graphitisation of Metals.

The B.C.I.R.A. have made arrangements with Professor F. C. Thomson, of Manchester University, for Mr. M. L. Becker to carry out an investigation on the influence of silicon, manganese and other elements, separately and conjointly on graphite formation. The work will be preceded by a preliminary investigation, under foundry conditions, into the cooling of castings.

The Electric Furnace in the Iron Foundry.*

By Victor Stobie.

As a foreword to this Paper, it should be stated that much of its contents is of the nature of suggestions; much is based on purely experimental work, and the balance is fact. As, however, the whole of it is based on many years' experience with electric furnaces in steelworks, it will probably give some food for reflection.

Among the facts which will be presented are data, which have been culled from the author's works' record books, in the manufacture of synthetic pig-iron, the refining of ordinary pig-iron, and the manufacture of some small and large castings from both the above kinds of irons.

Maximum Carbon Content in Synthetic Iron.

It will be of interest, firstly, to consider the question of the carbon content of some irons. The highest combined carbon met with in a commercial way is 4.6 per cent. It may be that a still higher carbon could be obtained experimentally in commercial plant, and it is known that a higher carbon content is present in cementite. Perhaps a recital of the circumstances under which the 4.6 per cent. carbon iron was produced will be of interest. Some 15 years ago in a Sheffield steelworks an electric furnace (not of the author's system) in which the whole of the current used for melting passed through the lining of the hearth of the furnace gave much trouble in consequence of the current overheating and softening the hearth. The people responsible for the furnace, being at their wits' ends in consequence of the continual loss of steel through its finding its way through the softened hearth, called in a certain consulting metallurgist to see if he could make suggestions to avoid a repetition of their troubles.

The consulting metallurgist decided that the difficulty would be overcome if the hearth were made of a material which would not soften at any temperature to which the plant might be subjected. Looking around, mentally, he found that carbon was in no way affected in solidity, all other matters being constant, by any temperature which could occur in the furnace, so he decided to make the hearth of the furnace of carbon. He also realised, with undoubtedly great pleasure, that carbon offered little resistance to the passage of current and that a hearth built of it would not, therefore, tend to overheat as a result of the current passing through it.

Carbon Hearth Used.

The hearth was ultimately constructed of graphite mixed into a paste with anhydrous tar. The hearth was shaped by means of rammers, and then the whole was heated up in order to drive off the volatiles from the tar and leave the hearth in a solid condition.

When the furnace was ready the steel scrap was charged into it for melting down in the ordinary way. When scrap is melted in an ordinary electric furnace some of its impurities are oxidised out by the addition of iron-ore or rolling mill scale. There is a slag on the material which takes up the impurities as they rise out of the molten steel, and it is necessary for this purpose that the slag be in a fluid condition. In the present case, however, the slag would not remain fluid, and considerable quantities of mill scale, iron ore, and sand were added to try to maintain liquidity. Almost as quickly as the mill scale melted and fluxed the slag the latter would return to its previous condition of solidity. This battle went on between the furnace and the metallurgist for about an hour after the steel was melted.

Ultimately, a sample was taken from the furnace and poured into the usual small test mould. On pouring the sample it was found to shoot stars of metal in every direction, and it was apparent that the conditions were by no means those normal at such a point in electric steel making.

The laboratory report was that the sample contained 1½ per cent. of carbon. At this period in a normal way there would be nearer 0.15 per cent. carbon.

Instead of realising what several onlookers had seen, the consulting metallurgist concluded that some of the graphite used in making the hearth had been left loose on the bottom of the furnace and, being absorbed by the steel, had upset the normal conditions, so he added a cargo of iron-ore to the bath. Matters did not progress and, after adding another shipload or two of iron-ore to the furnace, a laboratory report gave the steel as having reached something over 2 per cent. of carbon. From that point no further materials were added to the furnace, and the consultant went into the laboratory to check over for himself the method for determining the carbon. He found the method was, of course, quite a correct one, but another sample had to be taken out of the furnace and put through to satisfy him that he was not being misled. By the time that sample had been analysed, it showed a carbon content of about 3 per cent. The next test gave over 4 per cent. carbon, and the ladle was called up to the furnace. The ladle took about a quarter of an hour to prepare, and the furnace was tapped into it as soon as it arrived. The final sample taken of that steel showed it to contain 4.6 per cent. of carbon. The steel and not the furnace now contained most of the hearth!

One often learns by others' failures, and from this the author learnt to what extent combined carbon could exist in synthetic cast iron.

Many heats of synthetic pig-iron have been made since in electric furnaces in the author's works, but a higher carbon content than about 3½ per cent. has not usually been obtained. A higher percentage could regularly be produced if the cost of raising the carbon by such a method were not prohibitive. The commercial range of carbon in synthetic pig-iron is from about 2½ to 3 per cent. In all cases, this carbon was combined, but grey iron can be produced if required. The reason for the carbon being combined will easily be appreciated from the fact that all other non-ferrous contents of the metal were kept low.

Alternative Methods of Producing Synthetic Cast Iron.

Two methods of producing synthetic pig-iron have been worked out by the author, one consisting in melting and refining steel scrap and then, after the slag has been run off the metal, adding anthracite to the bath. The other method consists of melting and refining the steel scrap in one electric furnace, filling another electric furnace with the anthracite and getting the latter red hot, then taking the refined metal from the first furnace and pouring it over the red-hot anthracite in the second furnace. Both these methods give an ultimate product which is exceptionally strong and uniform in physical qualities. It is interesting to know that to obtain 3½ per cent. carbon in such pig-iron entails 50 per cent. more current being used than to obtain 2½ per cent. carbon iron. This is because the absorption of carbon by iron becomes slower the higher the carbon content of the iron, and, as current must be maintained throughout the whole of the process, the cost of producing synthetic pig-iron containing more than 3 per cent. carbon is uncommercial.

Oxygen in Cast Iron.

It will be remembered that during the discussion of Mr. Logan's Paper the author stated that experience in the manufacturing of synthetic pig-iron led one to the very definite conclusion that oxygen could easily exist in high carbon metals. Whether that oxygen is in combination or in solution in the metal perhaps cannot definitely be stated, but it would seem that as oxygen in combination could (if at all) exist in iron in much greater quantities than oxygen in solution, the

* A Paper read before the Newcastle Branch of the Institute of British Foundrymen, Mr. H. B. Herbst presiding.

probability is that oxygen exists as iron oxide in high carbon metal. When the synthetic pig-iron was made by adding anthracite to the refined metal, the resulting material contained what is usually but, in this case, would be erroneously called blow-holes. By adding a very small quantity of aluminium to the bath, the so-called blow-holes disappeared, and the metal became close grained. This closing of the grain did not result, in all probability, from any alloying of the aluminium with the metal as only the slightest traces of aluminium were found in the finished product, practically all having been oxidised in decomposing the iron oxide which was previously in the metal.

The synthetic pig-iron produced by the method of pouring the refined metal on to the top of the red-hot anthracite in a second furnace contained fewer blow-holes and required less aluminium to absorb the oxygen and close up the grain.

The iron produced by both these processes gave, in every case where it was tested, between 20 and 30 tons tensile on test pieces, cast in sand, having a cross-sectional area of ½ sq. in. turned from about 1-in. diameter.

Using up Burnt Metal.

For the purpose of making some special iron castings weighing each six or seven tons, the author has melted scrap cast iron in an electric furnace with a good measure of success.

The charge for these castings consisted of a mixture which would probably make many iron foundrymen shiver; it consisted of a little ordinary machinery scrap, a quantity of burnt metal and old ingot moulds. If it had not been that quite a lot of machinery scrap was at hand, the charge would have consisted entirely of the poorer cast-iron scrap and a few old ingot moulds. The reason for deciding on using the burnt metal was purely the commercial one of wanting to make as much profit as possible. The reasoning was as follows. The author never had any prejudice against what is called burnt metal. Burnt metal simply means cast iron which had been exposed in a solid state at red heat to oxidising influences. Burnt metal, when molten, appears to be just the same as any other metal of the same composition except that it is accompanied by a greater loss of weight in melting. Any shortage of silicon in that metal can be replaced on remelting by adding high silicon scrap to the charge, and any shortage of carbon can equally easily be made up. However, the proof of the pudding is in the eating, and those important castings made out of a major portion of burnt metal came out true to the required severe mechanical and physical tests.

Practical Difficulties.

The melting of cast iron in an electric furnace is different from the melting of steel in such a furnace in several ways. Perhaps the most noticeable is that resulting from the stillness of cast iron in the furnace as compared with the liveliness of steel during all the stages of the process. This results from iron being chemically much more stable when molten than is steel, principally due to the oxygen content of the iron being in equilibrium in the molten mass, whereas in molten steel oxygen is only in equilibrium when present in the most minute quantity. This statement is diametrically opposed to the generally held belief in regard to the effect of resident oxygen in such molten materials, but the many opportunities afforded of watching at great ease the behaviour of molten baths of cast iron and baths of steel in electric furnaces make the author assert the fact very dogmatically.

Resulting from the stillness of cast iron in the electric furnace, greater effort has to be made than with a bath of molten steel in order to get the greatest heat into the molten mass. This will easily be understood because in a furnace filled with molten steel the movement in the steel resulting from the chemical activity of the oxygen therein causes fresh parts of the bath always to be brought near the source of heat, whereas with the quiet molten cast iron one would have very highly heated iron near the arcs and relatively cold metal at a distance from them unless the furnace were efficiently stirred by rabbling, so as to bring all parts of the bath in turn near the arcs. If sufficient rabbling is not effected, the current consumption for melting cast iron will be as high as that required for melting steel, notwithstanding that the former melts at a much lower temperature.

Diesel Engine Iron.

In addition to the electric furnace being the only plant which can produce very high tensile synthetic pig-iron, the plant has many possibilities in an iron foundry for improving the quality of ordinary pig-irons.

For certain purposes, such as special Diesel engine castings, some metallurgists believe in using cast iron with a lower sulphur content than is normally available. It is realised that other and equally eminent metallurgists believe the exact reverse. It is not proposed to step in where doctors disagree, but for those who desire a low-sulphur iron this can be produced by using the electric furnace as an auxiliary to the cupola. The metal can be melted in a cupola in the usual way and then poured into an electric furnace. Under the influence of the electric arcs and a high lime slag, the sulphur can be considerably reduced in the iron. At the same time, the oxygen content of the iron can be reduced and the resulting product made to give a distinctly higher tensile result.

For the metallurgist who does not require to reduce his sulphur or may even desire to increase it, the electric furnace used along with the cupola will enable him very conveniently to increase his sulphur by additions of sulphurous materials to the iron after it is poured into the electric furnace, and at the same time he will have available the means of degasifying the cast iron and so considerably improving it prior to filling his moulds.

Melting Cast-Iron Borings.

Another direction in which the electric furnace should be of great help in iron foundries, especially those attached to large engineering works, is in re-melting cast iron borings. The author is not aware of the market position of cast iron borings on the North-East Coast, but he was told by the head of one of the largest British engineering concerns a few years ago that borings were such a glut in his district that he was actually disposing of as much as he could for nothing and that it was being used for the making of country lanes and roads. In any district where this condition does not obtain, these observations will, of course, have to be viewed according to the circumstances.

To melt cast iron borings in an electric furnace would require about 500 units of electricity per ton. With current at about ½d. per unit, the cost of the melting medium would be, approximately, £1. On the surface, this would seem to be a very good commercial proposition.

Making True Semi-Steel.

The subject of semi-steel is highly interesting in connection with electric furnaces. It will be apparent, from what has so far been said, that any intermediate composition between the usual steel and cast iron ones can readily be obtained by means of the electric furnace. It would seem difficult when making semi-steel in a cupola so to operate the plant as to obtain a reasonable degree of regularity in the molten material delivered by the cupola. By adding cast iron, melted in a cupola, and steel scrap together in an electric furnace, one can be sure of homogeneous metal being available for the foundry, and, if considered necessary, an analysis can be made of the material before the electric furnace is tapped so as to assure the desired composition of true semi-steel being obtained. Should the analysis when received from the laboratory not be that desired, it is the simplest matter to add either a little more steel or a little more cast iron to the furnace in order to adjust the composition. This may seem much extra work, but it must be realised that it is only by such control of metal that a thoroughly regular result can be obtained from a foundry. The cost of making the necessary analyses is indeed very small when one considers the enormous advan-

tage to a foundry of knowing what the metal actually is and, if necessary, adjusting it before the moulds are filled.

Better Control Instituted.

When melting cast iron in the electric furnace the foundryman is able to control the depth of chill which will be obtained in his metal when he is using chills in his moulds. This control is obtainable by taking out small samples of the molten metal from the furnace and casting them in small chill moulds. If the desired depth of chill is not obtained, small additions of known materials to the bath will quickly give the required chilling results. This would seem to be a most important matter in large castings when chills might have to be used at or near places where the castings have to be machined.

Another utility of the electric furnace in the iron foundry is where it is desired to make a heavy addition to the iron of some alloy such as chromium, silicon, manganese, etc. Adding such alloys to a cupola is most inconvenient, because one is never sure of the extent to which the alloys will be oxidised and slag off; also there is the loss of money which results from such slagging out of added alloys It must also be remembered that the cupola cannot deliver cast iron alloys having the regular composition which the electric furnace product will give.

Another advantage of an electric furnace to an iron foundryman is that he will have at hand apparatus which enables him, if he so desires, of turning his attention at any time to steel foundry work, which probably is a better paying proposition than iron foundry work!

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

The American Arbitration Bar.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—The American reply to Mr. Shaw's criticism is interesting. It appears to be quite true that the A.F.A. did not put forward the 1.2 in. dia. bar as an internation test bar, but is it equally true that the American Association for Testing Materials did not put this bar forward officially? If not, then the gentlemen who have been advocating it as an internation test bar must have been acting on their own initiative.

To a Britisher perhaps the most interesting feature of the American reply is America has at last realised that whilst their engineers are satisfied with a bar which is *supposed* to represent the metal in the ladle—whatever that may signify—the British engineer is not so easily satisfied, possibly because the latter—supported by his colleague, the British foundryman—is anxious to uphold Britain's reputation in regard to quality. This question of quality is a British characteristic, and it is hoped this trait will ever continue.

It is quite apparent that the Americans and ourselves approach the problem of castings from a totally different aspect, which almost leads to the supposition that in the States the founder dictates to the engineer the tests and conditions he is willing to give, whilst in this country it is the engineer who specifies tests.

Foundrymen and metallurgists in this country are anxious to work with the engineer to improve quality of castings, and the tendency is for the three to work together and help one another, which is all in national as well as individual interests in that British reputation for good workmanship must be upheld at all costs.

The American reply only confirms what individual Americans frankly admitted when their deputation visited this country in the autumn of 1923. One of their leading metallurgical authorities, when shown some of our problems, expressed himself—first in my office and afterwards in public—astonished at our great grasp of detail, particularly as to structure and causes, and it is this grasp of detail which is at the root of the difference between British and American practice.

Let me say frankly that in certain points of organisation, *i.e.*, layout, I take off my hat to American methods, and am glad many of their representatives who visited us agreed that they had a lot to learn from us both as regards quality and tests.

With regard to the test bars themselves, Mr. Shaw is quite able to uphold any attitude he may take up, and it is therefore unnecessary for me to deal with anything beyond the principles named above.

Yours, etc.

E. ADAMSON.

18, York Street, Sheffield.
May 1, 1925.

Book Review.

Pattern Making (430 pages), by Joseph G. Horner, A.M.I.M.E. Published by Crosby, Lockwood & Sons, 7, Stationers' Hall Court, London, E.C.4. 18s. net.

The author in his note to this, the 5th edition, states that the work has been considerably revised and enlarged. We think, however, that he could easily have made the book more useful had he severely pruned the sections on gears, machine, moulded wheels and mortise wheels. The present-day patternmaker is seldom asked to make any of these, but we think he would be interested in knowing, especially if he has been trained in the Midlands, how a modern turbine cylinder or condenser pattern is made in a marine district. Should he seek the aid of this book he will be disappointed. Further disappointment awaits him should he desire information on modern methods of mounting patterns for jar-ramming and other moulding machines, for he will find that 12 pages only are devoted to what is to-day one of the most important sections of the patternmaker's art, for it will be found that the success, from a technical standpoint of many installations of machines, has been largely due to the ingenuity of the patternmaker who mounted the patterns and conversely the failure of the patternmaker to rise to the occasion has resulted in at least partial failure. Yet, in spite of these faults, there is much sound advice, based on experience to be found in these pages, and many hints and warnings which the printer might have dressed in better type. The first 200 pages cover the principles of jointing and construction of patterns, and are sound, if somewhat conservative, but we think the examples might be more modern, and that some might be typical of the automobile and steam turbine sections of the engineering industry.

The appendix contains some tables and other useful data, and the index is fairly complete.

Foundry Query.

Chilled Wheels.

We are experiencing very great trouble in the casting of tramway wheels, which must be chilled. These wheels are 18 in. dia., with a 3-in. tread, and are solid, *i.e.*, spokeless.

Chills have been tried of various designs and thicknesses, made of cast iron, some with wrought iron bands cast in them, but in every case the chills split and open on the first wheel being cast in them. Our latest efforts have been with chills with bottoms to them, and rims of 4 to 5 ins thick in the thinnest part. Could any of your readers offer suggestions which might help us to overcome this difficulty?

"STILL UNCHILLED."

AN INTERESTING EVENT took place, on April 27, at the rolling mills of John Wood & Sons (Wisewood), Limited, when Mrs. J. T. Wood performed the ceremony of starting up the new 18-in. sheet mill which the firm have just installed. The mill will deal with all kinds of sheets up to 32 in. in width and up to 26 gauge, and it is intended ultimately to make provision for sheets up to 38 in. in width. The mill has been designed, built, and erected by the Brightside Foundry & Engineering Company, Limited, Sheffield, and is the only one of its kind in the Loxley Valley. It is electrically driven by a 250-h.p. motor, and at present comprises one pair of roughing and one pair of finishing housings, and crocodile shears driven from the mill shaft.

MACNAB & Co.

TABOR MOULDING MACHINES (TABOR PATENTS)

For Every Class of Work.

Pit Type and Portable Combination Shockless Jar Ramming Power Roll-over and Pattern Drawing Machines; Power Squeezing and Jar Squeezing Machines; Shockless Jarring Machines, etc., etc.

SPECIAL FEATURES AND ADVANTAGES:

Accurate Definite Draw with Permanent Accurate Alignment.

All Operations Controlled by One Lever.

Uniformity in size of Castings produced.

All Moulds squeezed alike to whatever Pressure Required.

Minimum Percentage of Wasters.

The above illustrates the TABOR POWER SQUEEZING "SPLIT PATTERN" MOULDING MACHINE, specially suitable for all small patterns which can be split in halves or for flat back Work.

A customer writes—

"The Machines draw perfectly in producing deep castings with the minimum amount of taper, and we are fully satisfied with them, as they are most economical in use and give the maximum production."

Capacities and Dimensions furnished upon application:

56/8, Eagle Street, Southampton Row, London, W.C.1.

Works: TOTTENHAM, LONDON, N.17.

Trade Talk.

The Siemens steel furnaces at the Ebbw Vale Company's works have been closed down for an indefinite period, and over 150 men have been thrown out of work.

The Greenock Dockyard have received an order for a cargo steamer for the General Steam Navigation Company. The vessel will be engined by Ross & Duncan, Glasgow.

The gas-fired annealing furnace installed at the works of A. S. Smith & Sons, of Walsall, is being used by the B.C.I.R.A. to complete the work of malleable iron previously carried out under laboratory conditions.

The United Strip and Bar Mills, Limited, to meet demands for quick delivery, and to facilitate operations in running their Morgan continuous mill, have now equipped a large warehouse for stocking common sizes of steel rounds and flats.

Vickers-Spearing Boiler Company, Limited, 20, Kingsway, London, W.C.2, have secured a contract for water-tube boilers through Kennedy & Donkin, consulting engineers, for the Calcutta Electric Supply Corporation, Limited. The contract includes buildings and complete equipment.

The Coronium Metal Company, Limited, of Brentford Foundry, Brentford, Middlesex, are transferring their entire plant and stock to more commodious premises at Reading Foundry, Reading. They are installing a new range of furnaces of improved type, and are also increasing the efficiency of their plant by additional new and up-to-date equipment in the machinery, finishing and white-metalling departments.

The Engineering and Allied Employers' National Federation states that there is no foundation for the statement made by Mr. Holt, district secretary at Manchester of the Amalgamated Engineering Union, that at the beginning of the year Sir Allan Smith gave an assurance to the Trade Unions that the working week would not be touched. On the contrary, at the conference on February 10, 1925, one of the points suggested by the Engineering and Allied Employers' National Federation for discussion was the effect of a reduction in hours.

Contracts have been placed by the L.M.S. Railway for locomotive tenders as follow: 4-6-0 passenger tender (experiment), Vickers, Limited, Barrow; 2-4-0 passenger tender, Ruston & Hornby, Limited, Lincoln; 0-6-0 freight tender, Ruston & Hornby, Limited, Lincoln; 4-6-0 freight tender, Vulcan Foundry, Limited, Newton-le-Willows. Further contracts for "bogie bolster," or long-rail wagons have been placed with the Metropolitan Carriage, Wagon and Finance Company, Limited, and the Midland Railway Carriage and Wagon Company, Limited, both of Birmingham, and with Clayton Wagons, Limited, Lincoln.

A deputation appeared before the members of the Cardiff Electricity Committee on Monday, April 27, asking for a reduction in the charge for current for electric melting. The deputation pointed out that the Cardiff firm were at a disadvantage to the extent of 27s. to 30s. a ton of steel melted compared with a similar plant at Pontypridd, due to the difference in the charges for current between the two places. Power at Pontypridd cost the melter 0.84d., whereas the Cardiff rate was 1.2d., and represented a difference of 1s. 6d. a cwt. on current charges alone. If the two firms got exactly the same orders, owing to the difference in the cost of the current the Pontypridd firm would be £500 better off at the end of the year. The committee eventually decided to supply power for electric melting at a ¾d. plus a fuel clause, which worked out at 0.867d., the consumer's light and current for other purposes to be charged at the usual rates.

Among resolutions adopted at the annual meeting of the No. 5 Division of the Iron and Steel Trades Confederation (which embraces Gloucestershire, Monmouthshire, and Glamorgan) was the following: "In view of the unsatisfactory condition of the staple productive industries of this country and the continued abnormal unemployment of the workers engaged therein, this meeting views with concern the lower economic standards and conditions of employment prevailing in Continental and other competing countries, and is strongly of opinion that the principle embodied in the fair wages clause as applied to contracts given out by the Government and public bodies should be made applicable to contractors and traders in such competing countries who are supplying manufactured goods to Great Britain. Further, without committing itself either to orthodox Free Trade on the one hand or Tariff Reform on the other, but with the object of advancing the principle above stated, this meeting decides that representations should be made accordingly in the event of any appropriate committee being set up under the Safeguarding of Industries provisions to consider the position of any section of the British iron and steel industry."

Obituary.

Mr. C. Hattersley, one of the founders of the firm of Hattersley Brothers, of the Queen's Foundry, Swinton, near Rotherham, died recently, aged 87.

Mr. T. Dunford, of Gosforth, has died at his residence, Oaklands, Gosforth. He was one of the principal engineers of Parsons' Marine Steam Turbine Company, Wallsend, with whom he had been practically since the inception of the company. He served his apprenticeship with the Wallsend Slipway & Engineering Company.

Mr. H. A. Barnard, whose death is announced at his residence, Holcombe Cottage, Olton, in his 78th year, was well known in the metal trades in Birmingham, where he was in business as a metal merchant and agent for many years. Mr. Barnard, who was the youngest son of the late Mr. William Barnard, of Nailsworth, Gloucestershire, had been a member of the Birmingham Exchange for over half a century.

Personal.

Mr. J. Winter, late assistant manager of the melting shop of Steel, Peech & Tozer, Limited, Phœnix Special Steel Works, Rotherham, who recently took up an appointment with Samuel Fox & Company, Limited, of Stocksbridge, has been the recipient of a presentation from the officials and men.

Wills.

Hill, C. J., of Coventry, chairman of Brett's Stamping Company, Limited... £6,549

Duncan, R., of Comrie, Perthshire, head of the firm of Ross & Duncan, engineers £55,705

Jenkins, J. G., of Cambuslang, Lanarkshire, iron and steel merchant, a former vice-president of the West of Scotland Iron and Steel Institute £28,760

Jones, T., of Blackheath, Staffs., founder of Thomas Jones & Sons, of the Standard Works, Halesowen, nut, bolt, and chain manufacturers £6,859

Company News.

Cement Gun Company (Great Britain), Limited.—Capital £1,000 in £1 shares.

Kieselguhr Producers, Limited, 15, Scething Lane, London, E.C.—Capital £1,000 in £1 shares.

Dennis Brothers, Limited.—Interim dividend, 1s. per share, or 5 per cent., on ordinary shares.

Midland Malleable Foundry Company, Limited, 73, Moland Street, Birmingham.—Capital £1,000 in £1 shares.

Hadfields, Limited.—Dividend on ordinary shares, 2½ per cent. per annum, less tax; carried forward, £80,522.

Atkins, Metals, Limited.—Capital £20,000 in £1 shares. Solicitor: R. H. Mayhew, 47, Temple Row, Birmingham.

Robert Stephenson & Company, Limited.—Loss, £3,611; dividend, 4 per cent., less tax, £8,525; carry forward, £36,899.

McIntyre & Sons, Limited, 9, Albert Buildings, Preesons Row, Liverpool.—Capital £30,000 in £1 shares. Engineers, boilermakers, ironfounders, etc.

Saxton & Company (London), Limited, 25-26, Piccadilly Mansions, Shaftesbury Avenue, W.1.—Capital £300 in £1 shares. Iron dealers. Directors: L. H. Saxton and G. L. Saxton.

J. R. Carruthers, Limited.—Capital £500 in £1 shares. Ironfounders. Directors: E. Harrison, 20, Bond Street, Dewsbury, and J. R. Carruthers, 13, Firth's Yard, Mill Road, Dewsbury.

C.A.C. (Radio), Limited, 10, Rangoon Street, Crutched Friars, London, E.C.3.—Capital £20,000 in 10,000 10 per cent preference and 10,000 ordinary shares of £1. Electrical and motor engineers, etc. Director: G. E. Ward (permanent managing).

Johnson & Phillips, Limited.—Profit, £161,965; maintenance of buildings, plant, etc., £24,000; interest on eight per cent. debenture stock, £25,564; debenture sinking fund, £15,217; income-tax and corporation tax, £4,468; depreciation on machinery and plant, etc., £12,281; available, £127,792; dividend, 10 per cent. on ordinary shares, less tax; carry forward, £77,792.

Richardsons, Westgarth & Company, Limited.—Profit, £48,215; brought forward, £68,977; total, £117,192; interest on four and a half per cent. debenture stock, £1,896; directors' fees, £2,500; depreciation, £10,000; writing off Heavy Stampings, Limited, £3,500; further dividend, 2½ per cent. on ordinary shares, making 5 per cent. for year; carry forward, £60,795.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The position of the Cleveland iron market at present may be regarded as practically stationary, the majority of consumers maintaining a waiting attitude, and refraining from buying except for immediate necessities. Meantime, demand on home account is only moderate, though there is a rather better inquiry from Scotland, while buying from abroad is spasmodic, the volume being very much below normal. Indeed, the trade is suffering to-day, as most other trades are suffering, from all-round under-consumption. At last week's market sellers adhered to 77s. per ton for No. 3 G.M.B. No. 1 was quoted at 81s. per ton, No. 4 foundry 75s. 6d., and No. 4 forge 74s. 6d. per ton.

In the Tees-side hematite market conditions continue dull, but on the whole, owing to restricted outputs, the tone has a steadier tendency, with the price of East Coast mixed numbers unchanged at 82s., with No. 1 quality at a premium of 6d. per ton. On the West Coast also a similar position is maintained, with Bessemer mixed numbers, 87s. 6d. per ton, c.i.f. Welsh ports; 92s. 6d. per ton, delivered at Glasgow; 97s. 6d. per ton, delivered at Sheffield; and 100s. per ton, delivered at Birmingham.

LANCASHIRE.—The local market for foundry iron is extremely dull, and only a small retail trade is doing. Sellers of Derbyshire No. 3 foundry iron are still trying to keep the price in Manchester at 85s. per ton, but it is an open secret that this quality can be bought at 84s., although, so far, one does not hear of less. Northamptonshire iron could be delivered at about 82s. 6d. per ton for No. 3, but it does not seem to be coming into this district.

THE MIDLANDS.—South Staffordshire ironfounders do not find business improving to any extent, and are experiencing strong competition for both light and heavy castings. Ruling prices for pig-iron are as follow:—Derbyshire No. 3 foundry, 75s. to 76s.; Staffordshire No. 3 foundry, 77s. 6d.; Northants No. 3 foundry, 70s.

SCOTLAND.—With most of the consuming industries on Clydeside still only partially employed or idle, Scottish pig-iron producers report quiet conditions, with quotations practically nominal for No. 3 foundry grades at 87s. 6d. per ton at furnaces.

Finished Iron.

A few of the South Staffordshire mills report a somewhat better volume of specifications in hand for bar iron, but the general situation remains disappointing on the whole. Prices are without change at £12 10s. for crown and £11 15s. for nut and bolt iron. Against these figures are the foreign offers of iron at £7 15s. delivered for a quality quite suitable for the Darlaston trade, and the bulk of the business now being placed must almost of necessity go abroad. With marked bars the position is totally different, as no Continental competition is feared, and the makers can adhere to the price of £15 f.o.t. The works making this grade of iron are by no means busy, but are well off in comparison with the other mills.

Steel.

At Sheffield, the feeling at the moment is a trifle less despondent, but it has not so far translated itself into business, which continues slow. Billet production has been slowed down to avoid adding to stocks, the demand for both basic and acid qualities being very restricted. The quotations for Siemens and Bessemer acid billets are unchanged. Crucible steel output has sunk to very low proportions, but the production of the cheaper classes is on a fair scale. The call for wire rods is weaker. In the tinplate trade, some of the works report fairly well filled order books to the end of the half-year, but there is no doubt that many are requiring specifications for June. Current quotations for the standard sizes may be called as follow:—Coke tins: IC, 14 by 20, 112 sheets, 108 lb., 22s. 1½d. to 22s. 3d. per box; IC, 28 by 20, 56 sheets, 108 lb., 22s. 7½d. to 22s. 9d. per box. All net cash, f.o.b. Bristol Channel ports. The price scheme has been dropped.

Scrap.

The outlook in the various markets for scrap material continues without improvement, and in some cases it is increasingly difficult to dispose of parcels of this description of metal except at sacrificial prices. In Lancashire, for example, ironfounders are expecting much lower prices for cast scrap, on the theory that pig-iron is cheaper, and reports are heard of 75s. being offered for good broken machinery; but, on the other hand, good cast scrap is not now plentiful in the district. There is also a scarcity of textile cast scrap now, and when a founder wants it for mixing purposes he is asked to pay 87s. 6d. per ton, but ordinary cast scrap can be bought at 77s. 6d. to 82s. 6d., according to quality. In Scotland machinery cast-iron scrap is still easy at 86s. 3d. to 87s. 6d. per ton, and for ordinary to the same specification, in pieces not exceeding 1 cwt. suitable for foundries, 5s. per ton less. There is no change in the price of cast-iron railway chairs at 85s. to 86s. 3d. per ton. Light cast-iron scrap and firebars are somewhat slow, and sellers now have difficulty in obtaining even 70s. to 71s. 3d. per ton. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—The lower tendency of values of standard copper continues unchecked, marking at the week end as much as 15s. below the lowest figure of last year. The explanation apparently is not so much a pronounced falling-off in consumption as over-production. Apart from this decline, conditions have proved very disappointing from the bull point of view, owing to lack of support from dealers and, at times, dragging and different demand from consumers. Current quotations: *Cash*: Thursday, £60 15s.; Friday, £59 10s.; Monday, £59 17s. 6d.; Tuesday, £60 5s.; Wednesday, £60.

Three Months: Thursday, £61 15s.; Friday, £60 10s.; Monday, £60 17s. 6d.; Tuesday, £61 5s.; Wednesday, £61.

Tin.—Notwithstanding less favourable advices from the East and America, the market for tin in London has latterly been distinctly firmer. There has been some expansion in demand from consumers, and with increased speculative buying, values have hardened, the close being firm at the best prices for some time. Estimates of the month's shipments from the Straits have been modified, owing to actual figures to April 20 amounting to 3,195 tons, and it is now possible that the total for the month of April will not exceed 6,000 tons. Current quotations:—*Cash*: Thursday, £245; Friday, £236 10s.; Monday, £238 5s.; Tuesday, £241 5s.; Wednesday, £242 15s.

Three Months: Thursday, £247 10s.; Friday, £239 10s.; Monday, £241 5s.; Tuesday, £244; Wednesday, £244 15s.

Spelter.—The business passing in this metal of late has been limited in volume, and apart from the trade buying, little interest has been taken in the market, which has been moving in unison with the other non-ferrous group. Current quotations:—*Ordinary*: Thursday, £34 5s.; Friday, £33 10s.; Monday, £34; Tuesday, £34 3s. 9d.; Wednesday, £34 6s. 3d.

Lead.—The market for soft foreign pig has been adversely affected by forced liquidation and aggressive selling of the forward positions. There has consequently been a very sharp fall in values, and consumers have been buying very little, as there is not much demand at the moment for manufactured lead add pigments. Current quotations:—*Soft foreign (prompt)*: Thursday, £32; Friday, £30 15s.; Monday, £31 10s.; Tuesday, £32 10s.; Wednesday, £32 2s. 6d.

The Plasstick Competition.

The General Refractories Company, Limited, of Sheffield, have asked us to announce that owing to a rush of late entries, and the high merit shown generally, they find it impossible to publish the result of their £100 competition this week. This competition, it will be remembered, included the presentation of a thesis on plastic refractories, with special reference to "Plasstick." It is mutual in scope, as the competitors are forced to derive benefit from the orderly arrangement of their thoughts on the subject, whilst the presentation of perhaps new aspects of the case will enable the organisers better to gauge the underlying principles, application, technique and scope of plastic refractories in general, and their own material in particular.

To Visit America.

Mr. W. H. Aston, managing director of the Aston Construction Company, of 46, Eagle Wharf Road, London, N., and Mr. J. Kelley, the foundry foreman, left yesterday by the s.s. "Homeric" for New York for a short business tour of the United States. Both are members of the London Branch of the Institute of British Foundrymen.

THE foundry department of Messrs. Joseph Rhodes & Sons, Limited, Grove Ironworks, Wakefield, owing to difficulties in supervising, is being taken over by a new company, which is to be floated.